

Development of a paediatric musculoskeletal curriculum for medical students

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I Declaration

This thesis is based on research performed through the Institute of Cellular Medicine, Newcastle University. Except for commonly held concepts, and where specific reference is made to other work, the content of this thesis is original. No part of this thesis has been submitted for the award of another degree.

II Acknowledgements

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III Publications and Presentations

Publications

Current teaching of paediatric musculoskeletal medicine within UK medical schools- a need for change

Jandial S, Rapley T, Foster H E

Rheumatology (Oxford). 2009 May: 48(5): 587-90

Doctors likely to encounter children with musculoskeletal complaints have low confidence in their clinical skills

Jandial S, Myers A , Wise E, Foster H E

J Pediatr. 2009 Feb: 154(2):267-71.

Presentations

Regional paediatric research trainees meeting, December 2010

‘Development of a paediatric musculoskeletal curriculum’

(Prize for best presentation)

American College of Rheumatology, October 2009

‘Development of a paediatric musculoskeletal curriculum’ – Poster

Association for Medical Education, September 2008

Why paediatric musculoskeletal medicine is in its infancy – Poster

British Society of Rheumatology, April 2008

Confidence in paediatric musculoskeletal clinical skills in primary and secondary care doctors

American College of Rheumatology, November 2007

Paediatric musculoskeletal teaching in UK medical schools – Poster

IV Abbreviations

ANA	Anti-nuclear antibody
BSCOS	British Society for Children's Orthopaedic Surgeons
BSPAR	British Society for Paediatric and Adolescent Rheumatology
CDC	Consensus Development Conference
COMSEP	Council on Medical Student Education in Pediatrics
CRP	C - reactive protein
DDH	Developmental Dysplasia of the Hip
DMD	Duchenne Muscular Dystrophy
ESR	Erythrocyte Sedimentation Rate
FBC	Full Blood Count
FG	Focus Group
FY1	Foundation Year 1 doctor
GALS	Gait, Arms, Legs, Spine musculoskeletal screening examination
GMC	General Medical Council
GP	General Practitioner / primary care doctor
JIA	Juvenile Idiopathic Arthritis
JS	Jane Stewart
MD	Doctorate of Medicine
MSK	Musculoskeletal
NGT	Nominal Group Technique
NHS	National Health Service
OSCE	Objective Structured Clinical Examination
pGALS	paediatrics Gait, Arms, Legs, Spine screening examination
PIL	Participant Information Leaflet
PMETB	Postgraduate Medical and Education Training Board
pMSK	paediatric musculoskeletal

R & D	Research and Development
REMS	Regional Examination of the Musculoskeletal System
RF	Rheumatoid Factor
SCFE	Slipped Capital Femoral Epiphysis
SJ	Sharmila Jandial
SpR	Specialist Registrar
UK	United Kingdom
US	United States

V Abstract

Despite the frequency of musculoskeletal (MSK) complaints in childhood, doctors involved in the care of children report low self-confidence in their paediatric musculoskeletal (pMSK) clinical skills and show poor performance. This is hardly surprising considering the little pMSK teaching delivered within UK medical schools and the perception that this is poorly done compared with other clinical skills within child health. This lack of pMSK education is likely to be significant when considering the delayed diagnosis and access to specialist care that affects many children with pMSK disease.

As any doctor could be involved in the care of children from the point of graduation, clinical skills and knowledge needs to be introduced at undergraduate level. Although efforts have been made to improve adult MSK education, this does not take into account the principles of child health and differences between adults and children. There is therefore a need to identify and agree on core pMSK educational content to be taught within the UK undergraduate curriculum. This should follow the principles of outcome-based education as practised in UK medical schools.

This study has identified the content for a pMSK undergraduate curriculum. Focus groups and interviews were held with medical students, and key stakeholders within pMSK medicine and child health. Participants proposed content for pMSK teaching and identified the barriers within the current teaching environment. Expert consensus was then achieved on curriculum content using a Delphi process followed by a Nominal Group Technique.

The final pMSK curriculum comprised learning outcomes (n=47), core presentations (n=8) and core conditions (n=14). These should inform the rest of the curriculum content and could be included in undergraduate child health teaching at all UK medical schools. It is hoped that by delivering this curriculum, all graduating doctors will then be equipped with the appropriate clinical skills and knowledge to assess all children with pMSK presentations, and will ultimately improve patient care. Further work is needed on implementation and evaluation of this curriculum.

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Chapter 1 Introduction

1.1 The need for this study

This study aimed to develop a paediatric musculoskeletal (pMSK) curriculum to be delivered within undergraduate medical education at UK medical schools. This thesis will describe and discuss the rationale and need for this study, the methodology chosen, overall results and final conclusions.

The following statements led to the development of this study and will be discussed in detail in this chapter, with reference to published literature.

- Musculoskeletal (MSK) complaints in childhood are common with a wide spectrum of potential diagnoses
- Diagnosis relies on competent clinical skills in assessing doctors, which are poorly done at present
- There is a recognised delay in access to care for children with pMSK disease to which poor pMSK clinical skills in assessing doctors may be contributory
- pMSK teaching is delivered infrequently at UK medical schools at present with no consensus on core pMSK educational content or delivery

The planned objective for this study was to define the content for a pMSK curriculum to be delivered at the level of undergraduate medical training.

1.2 Overview of chapter

In this chapter, a critical review of relevant literature provides justification for the study. An epidemiological review describes the frequency of pMSK presentations and diseases. The current state of pMSK clinical skills in practising doctors is explored, with emphasis on implications for the patient with pMSK disease in relation to delay in diagnosis and adverse impact on outcome.

A review of existing pMSK educational content is described with discussion on potential avenues to improve the current situation, drawing on educational initiatives within other medical specialties and exploring more specific requirements relevant to paediatrics. Finally, the definition of curriculum is discussed with focus on the implications for the methodology adopted in this study.

In summary, this chapter defines the problem within pMSK education, considered ways in which this can be improved, and provides background and context to curriculum design.

1.3 Definition of paediatric musculoskeletal medicine

The musculoskeletal (MSK) system refers to the muscles, joints, bones and soft tissues, and encompasses the specialties of rheumatology and orthopaedics within adult medicine. Symptoms of MSK problems include the patient complaining of pain or difficulty moving joints or limbs. Signs of MSK problems include swelling of joint or muscle, restricted movement of joints or limbs, tenderness or signs of inflammation (warmth or redness).

Paediatrics concerns the care of children from birth through childhood, puberty and adolescence. There is no defined upper age limit, but paediatric care is often provided until the end of secondary education. The patient can therefore be at any stage in the developmental continuum within childhood and adolescence. Within this thesis, the paediatric patient is referred to as ‘child’ throughout but with acknowledgement that this also includes the adolescent.

Paediatric musculoskeletal (pMSK) medicine refers to the care of children and adolescents with problems within muscles, bone and joints. Within the UK healthcare system, patients with MSK problems (such as pain or limp) present initially to their primary care doctor or emergency medicine departments. Initial assessment uses the clinical skills of history taking and examination, and will determine ongoing management; reassessment, investigation, treatment or referral to appropriate specialists. However there are specific challenges within paediatric clinical skills. History-taking often relies on the caregiver’s concerns and observations, particularly in the pre-verbal infant and child. MSK symptoms as outlined above may not be easily described by the patient themselves and may not be obvious to the caregiver. Examination depends on the child’s co-operation, and even when older, a child in pain may not readily consent to examination. Despite these challenges, assessing doctors must be able to evaluate the child before deciding on ongoing care.

The importance of this can be seen when taking the example of a toddler with difficulty walking. His problem could be related to a specific problem within the musculoskeletal system:

- Bone (developmental dysplasia of the hip (DDH))
- Muscle (Duchenne Muscular Dystrophy (DMD))

- Joint (Juvenile Idiopathic Arthritis (JIA))
- Neuromuscular problem such as cerebral palsy.
- Congenital orthopaedic problems such as leg length discrepancy (hemi-hypertrophy syndromes)

Perceived difficulty in walking may also be secondary to a non-MSK problem such as previous bottom shuffling or familial late walking which may be apparent on careful history taking.

It is clear that the clinical assessment warrants a global view and overlap with other specialities such as neurology or developmental medicine – referral to a pMSK specialist working within paediatric rheumatology or orthopaedics needs to be aware of the spectrum of causation and recognise when to involve other specialist colleagues.

pMSK medicine therefore refers to problems within muscle, bones and joints throughout childhood. The need for good pMSK clinical skills in assessing doctors is the main premise for this study and will be explored in more detail in later sections within this chapter. Prior to that, however, a review of pMSK epidemiology is required.

1.4 Epidemiology of pMSK disease

In this section literature was reviewed looking initially at the epidemiology of pMSK presentations, followed by specific pMSK conditions. Table 1 shows the incidence of pMSK conditions compared to other chronic conditions of childhood.

Table 1 Comparison of incidence data for musculoskeletal and non-musculoskeletal conditions in childhood

Condition	Incidence	Reference
Acquired musculoskeletal conditions		
All rheumatic conditions	32 – 42 per 100,000	Symmons 1996[1]
Juvenile Idiopathic Arthritis	10 per 100,000 (UK)	Symmons 1996[1]
Osteomyelitis	13 per 100,000	Riise 2008 [2]
Slipped Capital Femoral Epiphysis	9.66 per 100,000	Murray 2008 [3]
Legg-Calve-Perthe disease	5 – 15 per 100,000	Pillai 2005 [4]
Systemic Lupus Erythematosus	12.3 per 100,000 Rare in prepubertal children	Gardner-Medwin 2002 [5]
Henoch-Schonlein Purpura	20.4 per 100,000	Gardner-Medwin 2002 [5]
Chronic paediatric conditions		
Diabetes	15 – 20 per 100,000	Karvonen 2000 [6]
Inflammatory bowel disease	2.1 – 4.6 per 100,000	Griffiths 2004 [7]
Epilepsy	45 – 60 per 100,000 age >5 years	Wallace 1998 [8]
Congenital conditions		
Developmental Dysplasia of the Hip	5 in 1000 live births	Bialik 1999 [9]
Congenital heart defects	8 in 1000 live births	Hoffman 2002 [10]
Cystic Fibrosis	1 in 3000 live births	O’Sullivan [11]

Childhood MSK presentations to both primary and secondary care are common. Presenting symptoms and signs can be varied and the eventual diagnosis may come from a wide spectrum of conditions, leading to difficulties in ascertaining true epidemiological data. Published studies have looked at different populations and used differing methods of data collection, making comparison between results or grouping of results together hard to achieve.

A retrospective audit and case note review conducted in a UK tertiary hospital children's day-case unit found that problems within the MSK system accounted for 3% (84/2800 cases) of non-elective day case activity [12]. In Spain, where paediatricians provide a primary care service for all children, a prospective audit found that musculoskeletal pain was the cause of 6.1% of all visit to such a service, most commonly knee arthralgia [13]. These are different clinical situations and therefore likely different patient populations encompassing acute [12] and chronic [13] MSK presentations. These observations need to be explored further in larger studies although nonetheless, they confirm that pMSK presentations are not uncommon in general paediatric practice.

Within the adolescent population, Yeo & Sawyer published a review paper including data showing that 'musculoskeletal conditions' having a prevalence of 41 per 1000 adolescents [14]. This is more frequent than skin conditions, anorexia, diabetes and epilepsy; which traditionally have been thought of as chronic conditions affecting adolescent health. The source of this data is not given although the authors are based in the Australian healthcare system. It would be of interest to know if this was prevalence data was from primary or secondary care as there are differences in the conditions presenting to each level. Primary care prevalence data may include self-limiting presentations while conditions reaching secondary care may represent established MSK diseases.

Other findings support the common frequency of MSK presentations. In a retrospective survey of school age children and adolescents in Germany [15] 83% complained of pain in the preceding 3 months, with limb pain (33.6%) and back pain (30.2%) following after headache and abdominal pain in frequency. Back pain, limb pain and abdominal pain were significantly more likely to lead to a medical presentation than other sources of pain, suggesting that MSK pain is a significant cause of concern to this population or their carers. This finding cannot be used in direct comparison to findings above as the setting is community based, with populations of well children unlike the hospital or clinic based setting [12, 13].

Although the incidence of pain was high, many of these episodes may be self-limiting and therefore not seen within the medical system. However, the high frequency and level of concern found in this study cannot be ignored, and healthcare professionals must be proficient in assessing and managing MSK pain. Indeed, within the context of chronic pain in childhood, MSK was one of the commonest sources encountered by respondents in a recently conducted UK-wide survey primary care doctors and pain specialists [16].

No other published data to date includes pMSK presentations within the general population, making it difficult to fully establish the extent of the problem. It is likely that pMSK presentations and problems may vary with sex, ethnicity and age, which is seen in conditions such as hypermobility [17] and JIA [18]. This may be of significance when developing educational materials, which may require different emphasis depending on the target audience.

The epidemiology of pMSK problems has been looked at in specific sub-populations with particular significance for paediatrics. In children with cerebral palsy, a high incidence of both self-reported and carer-reported pain was found in a questionnaire based study across eight European regions ([19]. Although specific site of pain was not explored in this study, MSK pain is a significant source of concern in a study of adolescents with cerebral palsy [20]. This is consistent with findings from a smaller study of children with severe cognitive impairment [21] where episodes of musculoskeletal pain were present in 19%, representing 13% of total pain episodes in the population. This study, on non-verbal children (n=94, 53 male), relied on carer assessment and interpretation which could lead to bias, but it was clear that they perceived the MSK system to be an important source of potential pain. As traditional assessment skills such as patient history may be difficult to interpret, doctors involved in the care of this population need to recognise MSK symptoms as a source of distress.

Another relevant population is that of overweight children and the prevalence of MSK problems. In the US, overweight children were compared with non-overweight controls by retrospective chart review [22] and those in the overweight group were significantly more likely to have fractures, MSK discomfort, impaired mobility and malalignment of the tibio-femoral angle than the non-overweight controls. A review of children with Slipped Capital Femoral Epiphysis (SCFE) in Scotland suggested an increase in incidence in line with increased obesity in the population [3]. A recent study in Holland produced further useful data [23]. Individual interviews showed

significantly increased self-reported MSK problems in overweight (21.9%) compared to normal weight Dutch children (17.7%). This was compared with a national survey looking at family practice which showed similar findings, albeit lower; overall MSK presentations were recorded in 16% of overweight children compared to 14.1% of normal weight children. Overweight and obesity within children is increasing in the developed world [24], so the knowledge that this population have increased MSK complaints adds further weight to the importance of good MSK assessment.

These epidemiological studies have looked at the musculoskeletal system as a source of presenting complaint. It is not possible to determine an overall prevalence or incidence for pMSK presentations due to the differing data collection and populations studied. However it is clear that doctors both in primary and secondary care involved in the care of children are likely to encounter children with pMSK complaints and should therefore have the appropriate skills for assessment.

In terms of specific pMSK disease, it has been attempted to ascertain incidence and prevalence for rheumatological conditions in a number of studies.

Within the US healthcare system, Sacks identified a prevalence rate of 403/100,000 of 'significant paediatric arthritis and other rheumatological conditions'[25]. This was achieved by reviewing diagnostic codes relevant to paediatric rheumatology within visits to physician office, hospital outpatient and emergency departments. While this has produced useful and pertinent data, reliance on diagnostic codes may not truly represent the extent of paediatric rheumatological conditions. The implications of the US healthcare system must also be taken into account, and the authors acknowledge that those without health insurance may not be adequately represented in this study. Despite these concerns, valuable information on the prevalence of paediatric rheumatology conditions has been gained.

Juvenile Idiopathic Arthritis (JIA) is the commonest condition seen by paediatric rheumatologists, and it is therefore of interest to look at this populations specifically. Within the UK, a register was set up in 1989 to collect data from all paediatric rheumatology centres [1]. Data published from this register in 1996 gave a figure for JIA annual incidence of 10/100,000, and for all juvenile rheumatic disorders of 32 – 42/ 100,000, although will only account for children seen in centres contributing to the registry.

A worldwide variation in incidence and prevalence figures for JIA has been published, giving a range from 0.8 – 22.6/100,000 for incidence and 7 – 400/100,000 for prevalence [26]. A number of reasons have been proposed for this variation [26]:

- Studies on small samples may not produce truly representative results.
- JIA is diagnosed clinically without definitive markers or test results which may lead to diagnostic difficulties. This is further compounded by the changes in diagnostic criteria and disease classification that have occurred [27]. Experienced clinicians are more likely to detect evidence of arthritis on clinical examination compared to those less experienced[26].
- Studies defining epidemiological data have different settings and populations, making comparison difficult. It has been suggested that studies performed in the community by experienced specialists in pMSK medicine produced truer data than those looking at patients with established diagnosis.
- Ethnicity does appear to account for true differences in the epidemiology of JIA. Caucasian populations show a predominance of oligoarticular JIA, but in India this accounts for less than one fifth of all JIA with increased proportions of systemic-onset (one third) and polyarticular subtypes. Polyarticular JIA also predominates in other ethnic groups such as African Americans and native Canadians [18]
- Improving access to healthcare with time may have produced higher figures in studies undertaken more recently

Overall, these factors are likely to underestimate the frequency of JIA in studies to date and the author (Manners) suggests that true epidemiological data can only be achieved in a community based study conducted by pMSK experts using a large sample of children. Until this is done however, estimated incidence and prevalence of JIA is the current state of play and demonstrates that JIA is a significant chronic disease burden within child health (Table 1).

This epidemiological review has shown that pMSK presentations occur commonly within the child health population. Musculoskeletal disease within paediatrics is a true phenomenon, and has comparable incidence to other childhood problems conditions. Doctors involved in the care of children are therefore likely to see children with pMSK complaints and need to be able to perform a competent clinical assessment in order to detect those with significant disease requiring prompt referral,

and reassure and manage others. Clinical skills and knowledge are therefore needed to appropriately assess children with musculoskeletal presentations.

1.5 Are doctors involved in the care of children competent to assess children with pMSK presentations?

The doctor's role in assessing children with pMSK presentations is important as described in section 1.3. With the knowledge that pMSK presentations are common in the child health community, it was then important to ascertain if doctors involved in the care of children were able to appropriately assess them.

1.5.1 Current pMSK clinical skills

An early premise for this study was that pMSK clinical skills were poorly done by doctors involved in the care of children. This was supported by pilot work for this study. A questionnaire study on doctors' self-rated confidence in pMSK clinical skills was distributed to trainees working in the Northern region in specialties involved in the care of children: primary care, paediatrics, emergency medicine and orthopaedics, alongside primary care principal doctors and consultant paediatricians[28]. Participants were asked how confident they were in their pMSK clinical skills, and if they could recall pMSK teaching at undergraduate or postgraduate level. Additionally, they were asked to compare their self-confidence in pMSK clinical skills compared to other bodily systems. Most respondents had 'no confidence' or 'some confidence' in their pMSK clinical skills; 50% recalled pMSK teaching of which the majority was at postgraduate level. Compared to pMSK, respondents were more confident in assessment of other bodily systems with the exception of eyes and skin.

From these findings it is unsurprising that doctors are not confident in their pMSK clinical skills as they are not receiving appropriate teaching. The low pMSK confidence compared to other systems suggests this is not a general child health education problem but a specific pMSK education concern that must be addressed.

An obvious criticism of self-reporting confidence is that this does not necessarily correlate with poor performance [29]. However a prospective case note review within the UK looked at performance of pMSK clinical skills through evidence of documented pMSK assessment [30]. In 257 paediatric admission notes, a pMSK

history was documented in 2.7% and pMSK examination in only 1.6% of case notes. Even when the presenting problem related to the MSK system this low frequency persisted. There is therefore evidence of both low self-confidence and poor performance within pMSK clinical skills in a population of doctors involved in the care of children.

A questionnaire study of 251 graduating family practice residents in the US showed they were more confident in management of non-MSK conditions compared to MSK [31]. Those with orthopaedic rotations had higher self-rated confidence than those without, suggesting that increased training and exposure can improve confidence. This is consistent with the UK study described above.

Little is published on assessment of pMSK clinical skills. Within general MSK medicine a basic competency examination was administered to US residents in family practice, internal medicine, paediatrics and emergency medicine [32]. Only 8/38 residents were deemed to have 'passed' this assessment of knowledge. No paediatric residents passed and this group showed evidence of less MSK training than their counterparts. Although this was a small population assessed, it does still highlight a lack of knowledge.

What this information shows that doctors are lacking in knowledge and confidence within pMSK medicine, which is impacting on actual performance within clinical practice. The next question to ask, therefore, is does this have any impact on the patient and doctor?

1.5.2 Difficulty in making a diagnosis

pMSK presentations have a wide spectrum of causation and diagnosis rests on competent clinical skills and knowledge of when to be concerned.

Common presentations to primary care or emergency medicine include the child with a limp, MSK pain, single or multiple swollen joints or non-specific features such as fever and rash. Each of these presentations can be due to a wide range of MSK conditions [33] and require careful assessment to determine the most likely diagnosis. Differentiation between serious and benign conditions is key and relies on the core clinical skills of history taking and examination. Detection of 'red flag' symptom or signs may suggest the diagnoses of MSK infection or childhood malignancy [34, 35].

Within paediatric rheumatology, the majority of inflammatory conditions seen in this specialty are without diagnostic tests and rely on clinical judgement to establish diagnosis [26, 36]. Doctors have often received training in the assessment of adults with MSK presentations and may be confident in diagnosing adults with inflammatory arthritis who present with joint pain and stiffness [37]. However in paediatric practice reliance on these symptoms may not be helpful. In a study reviewing presenting signs and symptoms for children with JIA [38], joint pain was the commonest reason for referral. However, their findings showed that joint pain in isolation was unlikely to be due to inflammatory arthritis ($n=1/111$), meaning pain as a symptom was a poor predictor of JIA in such a clinical setting. Patients with JIA were more likely to have joint swelling and/or gait disturbance. In the same study population a positive anti-nuclear antibody (ANA) or rheumatoid factor (RF) at referral did not make the diagnosis of JIA or other inflammatory conditions more likely. In a different study looking at all referrals to a paediatric rheumatology service, 31% had an eventual diagnosis of idiopathic musculoskeletal pain as opposed to an inflammatory condition for which the referral was often made [39]. Idiopathic MSK pain is a diagnosis of exclusion and invariably requires specialist diagnosis and management. Clearly pain per se is a common but non-specific symptom and requires careful assessment but may not always have a clear cause – this highlights the difficulty doctors may have in detecting identifying inflammatory MSK conditions and need for increased awareness of appropriate MSK clinical skills.

Diagnostic difficulty has also been highlighted within paediatric orthopaedics. Consecutive referrals to a US paediatric orthopaedic service were reviewed according to the American Academy of Paediatrics classifications of orthopaedic conditions [40]. Of interest were the ‘inappropriate’ referrals. Within this category were 41.6% of the initial referral diagnoses (i.e. before patients were seen in clinic), increasing to 61.7% once the final diagnosis was given by the consultant orthopaedic surgeon. In those referrals that did not require any treatment, 91.3% were classified as ‘inappropriate’ at the initial referral diagnosis. 40% of all referrals were given an eventual diagnosis of normal or benign torsional and angular variants that could be seen in primary care and reassured; the authors argue that improved education could improve the referral pattern as avoiding unnecessary referrals are beneficial to both the patient and clinician. Although the setting of this study is that of a different healthcare system, the idea that referrals to a specialist pMSK service may be inappropriate is relevant to the UK healthcare system, and the potential to improve this through education is an important concept for this study.

1.5.3 Delay in access to care

The difficulties within making pMSK diagnoses have therefore been discussed. An examination of what impact this has on the patient is now required. In this section the recognised delay in diagnosis and access to specialist care for children with pMSK diseases is reviewed.

Again using JIA as a model for pMSK disease, a delay in diagnosis has been reported in different communities.

JIA, by definition, includes all subtypes of inflammatory arthritis with onset before age 16 and duration of longer than 6 weeks [41]. There are seven subtypes [27] namely oligoarticular, RF negative and RF positive polyarticular, systemic-onset, enthesitis related, psoriatic, and undifferentiated. Prognosis varies between subtypes with ‘oligoarticular’ felt to have the best outlook. However, this subtype also has the association of uveitis, an asymptomatic inflammation of the eye that can lead to visual impairment. Classification therefore has an impact on treatment, management and prognosis.

Recently published ‘standards of care for children and young people with arthritis’ advise that paediatric patients with a suspected diagnosis should be referred to paediatric rheumatology for assessment within 6 weeks of symptom onset [42]. Referral within this timescale would allow for prompt treatment and early detection of uveitis. However, a delay in the diagnosis of JIA has been recognised in the UK and worldwide. Within the UK, Foster reported on a three year observational study with a cohort of 152 patients referred to paediatric rheumatology within an eventual diagnosis of JIA [43]. Case note review showed a median interval from symptom onset to tertiary care review of 20 weeks, with a range of 0 – 416 weeks. The ‘extended oligoarticular’ subtype had the longest delay. When first seen in paediatric rheumatology 89% had active disease, and 89% had evidence of restriction of movement at 1 or more joint movement indicating previous inflammation. One patient in this cohort had untreated active uveitis. This study shows a clear delay in diagnosis, resulting in patients with untreated joint inflammation, restriction of joint movement, and potential uveitis.

A UK study following children with arthritis prospectively [44] has looked at symptom duration prior to diagnosis. 21% of patients in this cohort had symptoms for longer than one year prior to diagnosis. Compared to those with shorter symptom duration, this group were found to have higher active and limited joint counts at

diagnosis, with lower inflammatory markers (Erythrocyte Sedimentation Rate (ESR) and C Reactive Protein (CRP)). This suggests that referring doctors may have been reassured by these normal investigations; this highlights the need for good MSK clinical skills as investigations are often not helpful in diagnosis in JIA [36].

Similar delay in access to care has been reported worldwide [45] and show a widespread delay in accessing paediatric rheumatology care for children with JIA. Canadian data from British Columbia showed a median wait of 199 days from onset of MSK symptoms to being seen by paediatric rheumatologists, with children being seen by multiples healthcare professionals before definitive diagnosis made [46]. In Germany, a retrospective review of patients referred to a paediatric rheumatology clinic showed a delay in accessing this specialist care [47]. First visit to a healthcare professional was often early (median 10 days, range 0 – 1610 days) with subsequent delay to first visit to paediatric rheumatology of 90 days, range 0 – 2160 days. Patients referred by general practitioners or orthopaedic surgeons had a longer delay than those referred by paediatricians. Australian data was on a smaller retrospective case note review of 42 patients [48] and showed a mean delay between symptom onset and tertiary paediatric rheumatology review of 39.9 weeks, with range 1 – 208 weeks.

Other pMSK conditions have a reported delay in diagnosis. MSK presentations of childhood malignancy, such as bone or joint pain, limp or swelling are common [34, 49]. Indeed, in a retrospective review of 122 children with acute leukaemia, 38.3% had MSK complaints at the time of diagnosis, with 40.2% having x-ray abnormalities such as osteolysis or pathological fractures [50]. A review of delay to diagnosis in childhood cancer looked at different factors that could lead to delay: those within the patient, due to the cancer, and those within healthcare e.g. ‘physician delays’ [51]. Analysis was performed according to the cancer subtype as opposed to mode of presentation, meaning specific musculoskeletal presentations were not looked in detail. Overall, delay varied from 2.5 weeks for neuroblastoma to 29.3 weeks in brain tumours, with ‘physician delays’ longer than ‘patient delays’. The authors suggest that this signifies patients seeking medical opinion in a timely fashion, but the delay occurs between first physician review and appropriate ongoing referral. Whether this is due to lack of education or awareness is not known but is considered to be a factor in this paper. This is another pMSK disease group with a delay in diagnosis with potential to affect patient outcome.

Duchenne Muscular Dystrophy (DMD) is a genetically acquired X-linked neuromuscular disorder [52]. Affected individuals have an abnormal gene for muscle protein leading to weakened muscles. It most commonly presents in boys with delayed walking and signs of proximal muscle weakness; early death results from respiratory failure. Although no cure is known, early intervention can encourage muscle strength while supporting and educating the family and care is provided by paediatric neurologists. Genetic counselling is of utmost importance for families planning on having further children. An early diagnosis is therefore beneficial to the patient and family. However, a recent case note review within a UK children's hospital [53] showed a mean age of 4.5 years at diagnosis which is comparable to those reported elsewhere. A number were referred to orthopaedics or rheumatology due to abnormal gait patterns prolonging the delay to accessing appropriate care. The authors feel that DMD should be diagnosed earlier and highlight the importance of education on the presentation of DMD and need for early referral.

Reasons for delay in referral in all these conditions are likely to be multifactorial and are not explored in depth in publications to date. Possible reasons for delay are discussed in the literature summarised above; these include the patient and carer/family, who may not recognise the need to seek medical advice due to reasons such as lack of disease awareness or limited access to health care. Once involved, the initial and subsequent assessing doctors need to be equipped with the pMSK skills in history taking and examination to enable an appropriate assessment. There is evidence that this may not be the case, however, with the known low confidence and poor performance within doctors' pMSK clinical skills [28, 30]. Finally, doctors need to be aware of the range of conditions associated with pMSK presentations and how to differentiate between these and refer in an appropriate and timely fashion. Diagnostic difficulties within JIA have been highlighted previously and relate to the absence of diagnostic tests and false reassurance that normal investigations bring [26, 37, 38, 54, 55]. Assessing doctors need to differentiate normal from abnormal using appropriate clinical skills. Education in order to raise awareness of pMSK conditions and their presentations is likely to be of benefit.

1.5.4 Long term problems of pMSK disease

Recognising the difficulty in establishing the diagnosis, and seeing a delay in diagnosis of pMSK disease, it was then important to establish what long term implications this could have.

Outcome and prognosis for children with JIA in the 1990s [56] showed low mortality but significant morbidity. Disability was seen in the polyarticular and systemic-onset subtypes of JIA, and active arthritis persisted into adulthood in all subtypes.

Associated uveitis, with the potential for visual impairment and blindness, was also a significant concern.

Treatment for JIA has changed over the last decade with paediatric rheumatologists moving towards earlier and more aggressive management to suppress inflammation within the joint [57]. Intra-articular steroid treatment has been shown to prevent leg length discrepancy when compared with control patients [58] and is therefore considered early in treatment. The introduction of biological therapy such as Etanercept has been beneficial[57]. Initial trials showed short term safety and efficacy which has been further established in longer term data of up to three years [59, 60]. Patients report an improvement on quality of life measures while on etanercept [61] and there is emerging evidence of improved growth [62] and reduced radiographic progression [63] in patients treated with etanercept. Ongoing observational studies will provide more information at a later date but these findings all suggest that patients with JIA need to be seen by paediatric rheumatologists at an early stage in their disease in order to plan and discuss their treatment. If this is done appropriately, it can only improve outcome for children with JIA.

The long term impact of other pMSK diseases should be considered.

Bone and joint sepsis can present with pain or swelling in bone or joint, or unexplained fever [64]. Long term sequelae include limitation of joint movement, limp, leg length discrepancy and abnormal bone growth [65]. Early recognition of these infections with prompt treatment may prevent these complications.

Legg-Calvé-Perthe disease is a condition caused by avascular necrosis of the femoral head, seen most often in boys age 4-8 presenting with a limp [66]. Management is by paediatric orthopaedics and depends on X-ray classification. There is the potential for degenerative changes of the femoral head leading to osteoarthritis in early

adulthood [67]. Poorer outcome is associated with younger age [68] (4 – 6 years), older age (>8 years) and with certain x-ray classifications [68, 69].

Developmental dysplasia of the hip (DDH) is screened for in the newborn period, but if undetected at that time may present with delayed walking or asymmetrical gait [66]. This delayed presentation has an estimated prevalence of 1.3/1000 [70], and can be associated with adverse outcomes including acetabular dysplasia, avascular necrosis and osteoarthritis. Poorer prognosis is associated with older age at operation, high dislocation, subluxation, and growth disturbance on follow up. Even in those detected early, avascular necrosis may occur in up to 60%, and there is potential for those affected to require hip replacement at a later date.

In summary, many pMSK conditions require treatment with risk of long-term morbidity. There is therefore a need to ensure that doctors involved with the care of children have the appropriate skills to detect these conditions, institute appropriate initial management and refer appropriately and timely for specialist care.

This section has discussed the epidemiology of pMSK diseases. Despite their frequency, there is a delay in diagnosing pMSK diseases with long-term implications for the patient. Doctors involved in the care of children have low self-confidence in their clinical skills and it is likely therefore that pMSK clinical assessment is poorly used or interpreted. Prompt and appropriate treatment is necessary for many pMSK diseases, and relies on the doctor seeing the child making the appropriate assessment. There is therefore a strong case for improving pMSK clinical skills in all doctors involved in the care of children, with the ultimate aim of improving outcome for children with pMSK disease.

1.6 Current pMSK education

1.6.1 What is being taught at present?

From pilot data it was established that doctors recall little pMSK teaching [28]. Establishment of what pMSK education currently exists was therefore necessary.

Within UK medical schools general paediatric clinical skills are usually taught together within specific child health rotations. In keeping with this, lead rheumatology teachers at UK medical schools do not see pMSK clinical skills as ‘core’ skills to be included within adult MSK teaching [71].

It was felt pertinent to review pMSK teaching within child health rotations at UK medical school as pilot work for this study [72]. UK child health leads were surveyed on pMSK content within their delivered curricula and their perceptions on the importance of pMSK teaching. pMSK medicine was taught in a minority (history in 9/23 responding schools, screening examination 8/23, regional examination 5/23) and rarely featured in assessment. Child health leads felt pMSK clinical skills were as important as other clinical skills (i.e. other bodily systems) but that they were less well taught. There is therefore a need to improve this current state of pMSK education within UK medical schools and this would be welcomed by child health leads.

There are no other similar studies looking at undergraduate pMSK education currently published. Within postgraduate UK primary care, trainees within the UK feel they have inadequate pMSK training [73]. In a study of US paediatric residencies, pMSK examination was included in only 29% of programs and was deemed to be poorly taught [74]. General paediatric sports medicine training was felt to be inadequate in this study and also in US adolescent residencies [75].

A reason for this low frequency of current teaching may be the lack of current consensus on what should be taught for pMSK medicine. Some recent work has tried to improve this. Within the remit of the Bone and Joint Decade [76], consensus methodology was used to develop recommendations for an undergraduate MSK curriculum [77]. Although primarily focussed on adult MSK medicine, pMSK content was included. However, this was without input or discussion from paediatric rheumatologists or orthopaedic surgeons, general paediatricians or primary care doctors. It is therefore important to consider this content but it lacks the credibility that would be associated with involvement of pMSK and general paediatric experts.

The specific pMSK content was considered within this study design and discussed in Chapter 4.

The above proposed curriculum was used as to develop a postgraduate core musculoskeletal curriculum in Canada [78]. Consensus methodology in the form of ‘elite interviewing’ was used across a multidisciplinary panel that included rheumatology, orthopaedics, ‘family medicine’ (primary care) and emergency medicine. Although paediatrics was still not included in this panel, the inclusion of family and emergency medicine was important. Interestingly, these two specialties did differ in their perception on important items, with primary care representatives rating conditions such as congenital musculoskeletal conditions (e.g. ‘club foot’) and JIA as of greater importance than the emergency specialists. The authors comment that this reflects their differing patient populations within acute and chronic conditions, an observation that strengthens the argument for the views of all specialties involved in the care of children to be sought when seeking consensus on educational needs. Although a useful curriculum, it targeted postgraduate training within Canada and was not therefore readily transferable to the undergraduate population within UK medical schools

An undergraduate paediatric curriculum does exist in the US [79] and was developed by the Council on Medical Student Education in Paediatrics [80]. A national survey was followed by a Delphi process in order to achieve consensus on content [81]. This curriculum details the knowledge, skills and attitudes expected in relation to all aspects of paediatrics, including pMSK medicine (www.comsep.org). Examination skills (n=6 items) include neonatal hip examination, observation and description of gait, recognition of age-related variations and detection of pathology such as joint effusion. Knowledge of conditions (n=16) that could present with limp and extremity pain was expected. This is obviously a pertinent and useful curriculum to be considered within this study. However implementation has not been universal. National surveys showing a gradual increase in use of the curriculum [81] but this differs by section; ‘growth’ was taught by 88% schools and ‘child abuse’ by 40%. The extent of pMSK teaching has not been reported. Barriers to implementation have been clearly highlighted in the form of inadequate time, lack of financial support and lack of control of curriculum at affiliate sites [81]. These are likely to be similar in the UK as highlighted in other studies [82-84].

While the COMSEP curriculum is important, it cannot be extrapolated directly to the UK. Medical education systems differ, with the UK’s model of a 5 year undergraduate

education as opposed to the US 4 year graduate programme. Consideration must also be given to the population to which the educational system applies. The US and UK differ in healthcare access and organisation, which includes the interaction between primary, secondary and tertiary care. The educational system must take into account the ways in which patients present within that healthcare system in order for doctors to be able to provide appropriate assessment. Ethnic distribution is a further consideration, with significant diversity between the countries, which is likely to impact on the conditions seen [18]. It must also be remembered that the UK undergraduate medical education system is focussed on preparing the student for graduation and their work within the Foundation programme [85, 86] and any educational interventions must take this into account. pMSK teaching for UK medical schools needs to incorporate the views of students and teachers within this system, and consider the needs and barriers this specific population face.

1.6.2 How can we improve pMSK education?

Within pMSK medicine there have been some attempts at improving education. The development of a teaching session on knee and ankle examination for US paediatric residents showed improvement in assessment performance at one and nine months compared with baseline [87, 88]. Students watched a video, observed the examination being performed by a specialist before performing the examination themselves and assessment included knowledge (written test) and skills (Clinical Assessment Exercise). The use of a longer term assessment was useful in this study as it takes into account the Hawthorne effect [89], the phenomenon of improvement of performance in subjects who know they are being observed and watched.

A further pMSK teaching development was the paediatric Gait, Arms, Legs and Spine (pGALS) screening examination [90]. The original Gait, Arms, Legs and Spine screening examination (GALS) was developed by physicians as an example of best practice and tested on adult patients [91, 92]. GALS has been taught to all UK medical undergraduates since 1995 and has been shown to improve doctors and students confidence in MSK assessment [93, 94]. Prior to GALS, an audit of admission notes found poor performance in MSK assessment [95]. This audit was repeated following the introduction of GALS to the undergraduate curriculum, and although an improvement was seen in documentation of MSK assessment, this was still less frequent than other bodily systems [94]. However these improvements in

confidence and performance were seen as encouraging and GALS is now taught in all UK medical schools.

In order to adapt GALS for the paediatric population, additions were required to account for the different presentations between adult and paediatric MSK disease. These additions were achieved using consensus methodology involving UK pMSK experts and subsequently validated in the school aged child, demonstrating good sensitivity and specificity to identify the normal from the abnormal child with respect to MSK assessment [90]. The screening examination is then to be followed by a more detailed regional exam based on the look, feel, move approach [96]. pGALS has been shown to be acceptable to patients and parents and has high sensitivity and specificity in the hands of pMSK experts. Recent work has looked at the use of pGALS in acute paediatric practice and has been shown to be practical and acceptable in the hands of the non pMSK expert [97], being quick to perform in the setting of a general paediatric assessment setting. Interestingly, in this study performance of pGALS revealed a high frequency of MSK abnormal findings even in non-MSK presentations (such as vomiting or ataxia) demonstrating that the interpretation must be in the context of the clinical scenario, and there is often overlap with other systems such as neurology in the child with abnormal gait. The authors acknowledge that the study was not intended to ascertain the incidence of MSK problems in acute paediatrics and therefore not appropriately powered to assess this, but the results are interesting and suggest further study is warranted.

At Newcastle University, pGALS was introduced to the child health curriculum in 2006. Pilot studies involving child health teachers gave positive feedback on general pGALS teaching but additional resources were requested to provide knowledge and context for teachers that were non-experts in pMSK [98].

In order to explore how this can be done it was felt appropriate to explore the way in which other medical subspecialties have addressed educational deficiencies.

1.7 Learning from adult MSK teaching

Within adult MSK education there is concern that there is insufficient teaching to reflect the high MSK burden within the community [76]. Curriculum analysis in Canadian medical schools showed a mean time of 2.6% dedicated to MSK medicine yet clinical exposure for practising primary care doctors was between 13.7 – 27.8%

[99]. In the UK, a survey of lead rheumatology teachers in 1990 and 1997 [71] showed a decrease in mean teaching time for MSK medicine over the decade.

A number of initiatives have been introduced to improve undergraduate MSK education. As described previously, an educational initiative that came from the Bone and Joint Decade was the development of the MSK curriculum [77]. This content was subsequently included in Wadey's study in Canada providing a validity to its content[78]. However no information is available on implementation or evaluation of either curriculum.

To accompany GALS, a systematic approach to regional examination of the musculoskeletal system (REMS) has been developed [96]. Initial evaluation of REMS showed good student performance within the Objective Structured Clinical Examination setting (OSCE) (data not published) and it is anticipated that this will be taught to all UK medical students alongside GALS. Other educational interventions in published literature include the use of region specific modules [100, 101], ultrasound as a teaching aid [102] and the involvement of students as teachers in Peer-Assisted Learning [103]. All of these studies produced improvements in the small number of students exposed. The introduction of new MSK courses in the UK [104]) and US [105] involved greater number of students and again produced improvement in student performance. It is not known if any of these interventions improve performance in practising doctors.

1.7.1 Barriers to teaching

As well as developing educational interventions within adult MSK medicine, the difficulties in delivering this teaching have also been described [82, 106]. These include the lack of agreement on teaching content, low confidence in MSK clinical skills in non MSK teachers, poor communication between specialties, poor anatomical knowledge in students, few inpatients on whom to teach and limited teaching time. These are similar to barriers recognised in teaching child and adolescent psychiatry [84] and public health [83] and are likely to be shared in paediatric practice.

Two studies looking at attitudes and perceptions within medical teaching have also highlighted the lack of time and limited resources available for teaching [107, 108]. This was particularly highlighted in a postal questionnaire study of consultants involved in undergraduate teaching [108]. Other concepts raised in this study related

to organisational problems in relation to the curriculum, and lack of preparation for clinical practice in the students. Teachers in this study also raised a desire for recognition of their teaching efforts.

A qualitative study of students and teachers allowed several other concepts to be explored [107]. During focus groups with students, they described consultants as important role models, and the high value of good consultant teaching. They disliked being humiliated or when teaching sessions were cancelled due to consultants being too busy. Consultants were interviewed about their teaching practices, which they generally enjoyed, but felt their clinical commitments were a priority. This was particularly true in settings such as outpatient clinics where the need to deliver patient care meant students were often left to observe the consultant at work. Concepts raised in this qualitative study may be relevant only to the setting and environment encountered by these consultants and students, but it will be of relevance to explore this further in relation to pMSK teaching.

Barriers specific to pMSK teaching are not currently known. An understanding of what prevents pMSK teaching may inform teaching methods and development of teaching resources, and will therefore be looked at in more detail within this study.

1.8 Children are not small adults

Educational materials for paediatrics must take into account the challenges and complexities of the child health population. It is not therefore possible to simply extrapolate adult MSK educational initiatives to paediatrics.

Students coming to paediatrics often lack confidence in examining children and applying clinical skills with a fear of causing pain or distress [109]. Consultations are often three-way in nature with the addition of the caregiver, and students require the communication skills to manage this [37]. The caregiver is also responsible for providing consent to examination [110] which may be considered an additional barrier within pMSK teaching alongside those already described within adult MSK teaching [82, 106].

Paediatrics within the UK is taught separately to adult medicine with child health rotations taking place within the later years of the medical curriculum [72]. This late teaching also occurs in the US, with concerns that a lack of exposure to child health teaching leads to few paediatric role models and an under-representation of child

health within final assessments [111]. This is important for future recruitment, with evidence that early experience and positive role models influence later career choice [112].

No agreement exists at present on core paediatric teaching content in the UK but it has been suggested that any paediatric curriculum must cover specific issues [113]:

- Context of child health
- Growth and development
- Behaviour and the wellbeing of children
- Disease recognition and management

Issues specific to child health are also highlighted in the US paediatric curriculum [80] as discussed in Section 1.6.1. Core principles related to learning paediatrics in their curriculum include understanding growth and development, knowledge of acute and chronic paediatric illnesses, the paediatric approach to health care and understanding the place of the community, family and social influences. Acquisition of clinical skills such as communication, physical examination, attitudes and behaviours appropriate to paediatrics are also highlighted.

pMSK educational interventions therefore must take into account the specific differences within child health practice such as normal development, growth and communication. The learning of pMSK clinical skills, such as pGALS [90] or detailed regional examination such as knee and ankle assessment [87], are insufficient in isolation and need to be considered alongside the clinical context as well as behaviours, attitudes, other clinical skills and knowledge. This needs to be addressed within a pMSK curriculum which currently does not exist.

1.9 Curriculum development

Taking into account the discussion thus far, the need to improve pMSK education provided to undergraduates is clear. Doctors involved in the care of children have low confidence [28] and show poor performance in their pMSK clinical skills [30]. This has a causal impact as evidenced by the incidence of children with pMSK diseases who have a delay in diagnosis and access to specialist care [43, 46-48]. Despite the consensus that pMSK clinical skills are important, in practice they are taught infrequently at undergraduate level in the UK [71, 72]. There are few educational interventions within pMSK medicine to date and teachers have requested the

addition of context and knowledge [72, 98] which must take into account the principles of child health [52, 80, 113]. In order to achieve this, any pMSK educational content to be developed must encompass clinical skills, knowledge, attitudes and behaviours deemed appropriate by both pMSK and child health experts.

This is in keeping with the general standards for undergraduate education set by the General Medical Council (GMC). Tomorrow's Doctors (2003) states: 'the core curriculum must set out the essential knowledge, skills and attitudes that students must have by the time they graduate' [85]. Newly graduated doctors in the UK may be involved with the care of children from their first job, with the Foundation Programme [86] including placements in primary care, emergency medicine, orthopaedics or paediatrics itself. To ensure doctors are able to assess children with MSK presentations appropriately, this study proposes that pMSK clinical skills are introduced at undergraduate level.

Educational deficiencies have been identified in other medical subspecialties, leading to the development of undergraduate curricula in psychiatry [114], anaesthetics [115] and dermatology [116]. In these studies, consensus methodology was used to determine the learning outcomes that students should attain.

This is in keeping with the model of 'outcome-based education' practised in UK medical schools at present [117]. The curriculum is driven by the outcomes that students should achieve. As the curriculum refers to the whole 'educational programme' within the subject of interest [118], it must consider more than teaching content alone; teaching and learning environment, teaching methods, assessment and evaluation are also required [119]. By firstly defining learning outcomes, teaching strategies, methods and assessments can be developed to facilitate achievement and testing of these outcomes. Assessments based on outcomes provide the student and teacher with structure and ensure accountability [117, 120]. For the overall undergraduate curriculum the outcome-based model reflects the knowledge, skills and attitudes required to practise as a newly qualified doctor [85, 121].

Learning outcomes are led by 'descriptors' which define the level of skill expected at each outcome [122, 123] and achieve multiple goals. Descriptors inform the student of what they are required to learn, guides the teacher in methods to allow students to achieve these outcomes, and the assessor on the desired capability of the student. This is an advantage in terms of accountability and transparency, providing structure for teaching, and opportunities for self-directed learning [117]. However there are

criticisms of learning outcomes. The restrictive nature of defining precise outcomes may limit both learning [123] and teaching [117] if opportunistic or creative educational events are not seen to be relevant. The descriptors themselves can be difficult to define [123] with recognition in the literature that too narrow a specification should be avoided [119, 124]. At times precise outcomes may be required, such as skills attainment, and will lend themselves well to assessment and evaluation. However other outcomes may be required to take into account qualities that are difficult to quantify such as judgement or responsibility [124] or reflect the wide spectrum of medical knowledge such as medical management and systems [125]. Careful consideration to both the content and construct of learning outcomes is therefore needed.

Achievement of clear learning outcomes can be difficult. Examples in the literature have used consensus opinion from relevant participants [117, 121, 126]. Often these are experts within both education and the subject under discussion; ideally then the final outcomes will reflect relevant and achievable content. Experts brought together may initially contribute personal knowledge and practice, but should move towards a shared expert opinion by listening to others and comparing ideas. This may be seen as a form of ‘collegial knowledge’ [127] and in this situation is superior to single expert opinion as it reflects a common view of experts. Collegiality has been described as a ‘commitment to preservation, validation, communication and extension of knowledge’ [128] and is therefore a relevant concept for curriculum development.

It has been proposed that outcome-based education promotes students into ‘active learning’ while motivating teachers to help students achieve their goals [117]. This curriculum model is not prescriptive in teaching environment and methods and should therefore be readily deliverable across different teachers, situations and schools. A good example of this is the core curriculum for Scottish medical schools [121] which could be delivered at all five Scottish schools despite their different approaches to undergraduate education. In this curriculum, core outcomes expected of all graduating doctors were developed in an iterative process involving experts in medical education based in Scotland. These outcomes refer to general principles within undergraduate education and are not disease or specialty specific. Involvement of experts within Scottish medical education reinforces the collegiality as expressed above as they have a shared commitment to improving medical education within Scotland.

One final concept relating to curriculum development is that of curriculum mapping [119, 129]. The goals of this are to allow students and teachers to clearly see what is expected within the curriculum ('transparency') and how different parts of the curriculum are linked [129]. By doing this, all those involved in the curriculum can view the different components: learning outcomes, assessment, learning opportunities and resources, environment, staff, students and developers. The links between these may show how a particular learning outcome can be achieved in terms of learning resources and teaching opportunities, how it will be assessed, and who will be involved in delivering teaching. In a recent study of curriculum mapping within UK and Canadian medical schools, 19% of responding schools had set this up, with a further 55% in the process of doing so [130]. While this study had a low response rate from UK medical schools (18/32) this still shows that curriculum mapping is an important concept in undergraduate medical education. This may be of particularly relevant for a pMSK curriculum where concepts may be covered in different areas of child health or indeed at different times in their educational programme. Students and teachers would therefore benefit from a clear picture of how this relates to the rest of the curriculum. The concept of curriculum mapping can also be used when considering the continuum of medical education through undergraduate and postgraduate training. When developing a curriculum with learning outcomes these should reflect the skill, knowledge or attitude required but these may need to progress during ongoing training. This can currently be seen in the competency-based specialty training within UK postgraduate medicine, for example the curriculum for paediatrics contains outcomes to be achieved at different levels of training[131].

Consideration of the outcome –based education model will be important when designing a pMSK curriculum. If the learning outcomes are first defined, the rest of the curriculum will then be informed ([117]. A shared expert opinion can be achieved using consensus methods and is recognised as the appropriate way to develop curricula [117, 121, 126]. As this curriculum model can be applied across different schools and teaching environments [121] it can be adopted across all UK medical schools, as other subspecialties have proposed [114-116]. This would ensure that all graduating doctors possess the knowledge, skills and attitudes relevant to pMSK medicine and hopefully improve care for children with MSK presentations.

1.10 Conclusions to Chapter 1

The rationale behind this study has been reviewed and discussed. Published evidence has supported the statements introducing this chapter:

- Musculoskeletal (MSK) complaints in childhood are common with a wide spectrum of potential diagnoses ranging from benign and self limiting to potentially life threatening.
- Diagnosis relies on competent clinical skills in assessing doctors, and performance of pMSK assessment is suboptimal at present.
- There is a recognised delay in access to care for children with pMSK disease; poor pMSK clinical skills in assessing doctors may be contributory.
- pMSK teaching is delivered infrequently at UK medical schools at present with no consensus on core pMSK educational content or delivery.

In order to improve the current pMSK educational environment the knowledge, skills and attitudes required must be defined. To ensure all doctors involved in the care of children possess these attributes, education should be targeted at undergraduate level. In this educational environment this is best done by defining learning outcomes which will inform a pMSK curriculum that can be delivered at any UK medical school. Learning outcomes will themselves inform the rest of the curriculum content and it is therefore of utmost importance to ensure these are identified in a robust and rigorous manner.

The aims for this study are described in the next chapter and will lead to a detailed description of the methodology.

Chapter 2 Aims

There was one overall aim for this study:

- To develop evidence based and consensus derived content for an undergraduate curriculum for pMSK medicine to be taught at UK medical schools

The specific outcomes to achieve within this study were:

- To establish the need to improve pMSK clinical skills in graduating medical students
- To identify barriers to pMSK teaching from the perspectives of students, teachers and pMSK experts
- To enable pMSK curriculum content to be proposed by students, teachers and pMSK experts
- To define learning outcomes based on both the content proposed and published evidence
- To achieve consensus from experts on the learning outcomes to be included within a pMSK curriculum

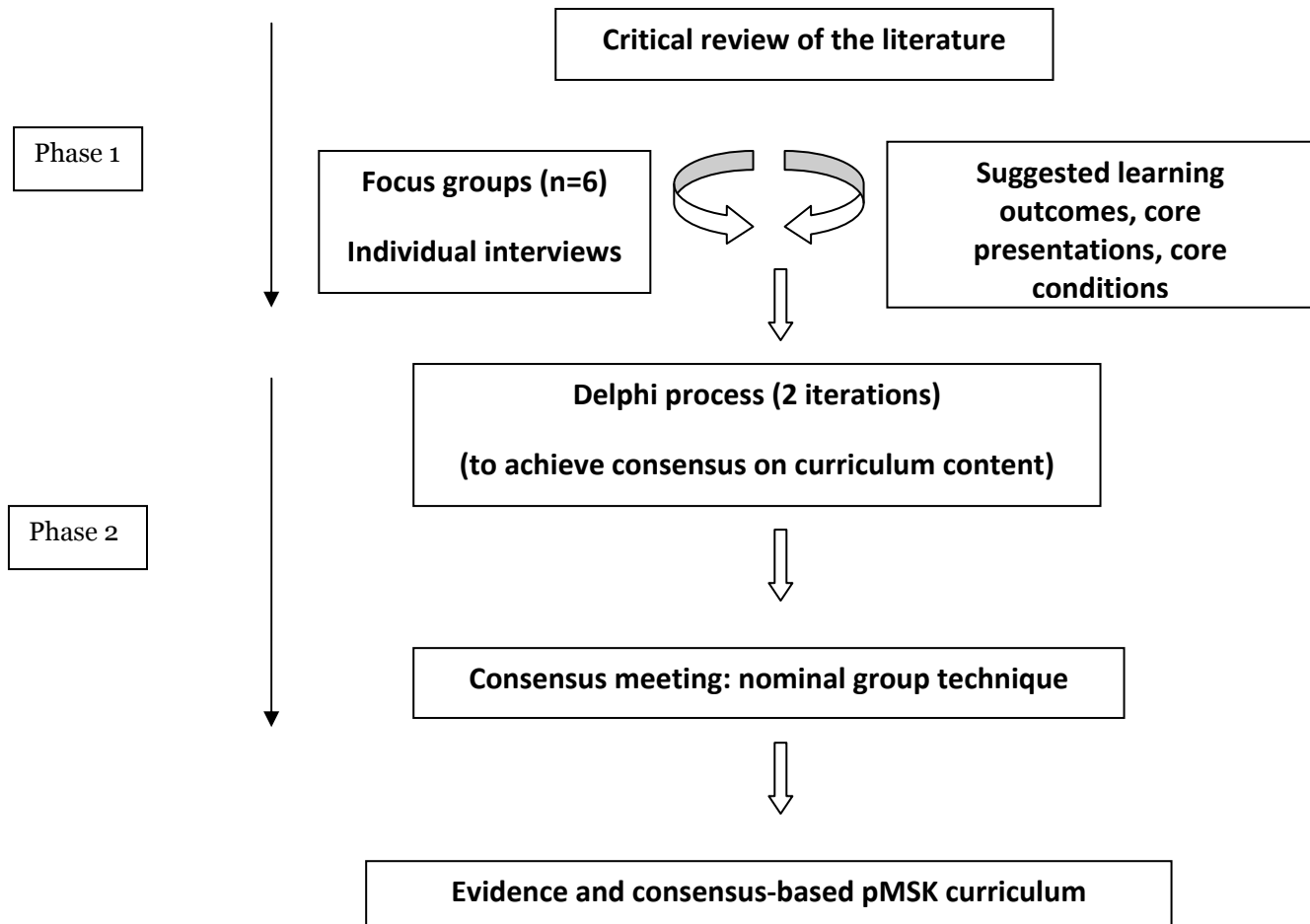
Learning outcomes will guide other curriculum content such as teaching methods and assessments but these will not be developed further in this study.

Chapter 3 Study design and methods

3.1 Overview

In this chapter the methodology will be described in detail; the rationale for this design, description of each stage of the methodology, ways in which rigour was maintained and limitations of the study design. This was a two-phase study with the aim of developing undergraduate pMSK curriculum content. In Phase 1, focus groups, interviews and a review of the literature generated data to inform the content of pMSK learning outcomes for an undergraduate curriculum. In Phase 2, these outcomes were reviewed by an expert panel, with a Delphi process employed to determine consensus on the curriculum content. To end Phase 2, a modified Nominal Group Technique allowed the final curriculum to be agreed. This design is shown in Figure 1.

Figure 1 Outline of methodology



3.2 Introduction

This study aimed to improve pMSK clinical skills and knowledge by developing content for an undergraduate pMSK curriculum. The need for this was discussed in Chapter 1 and includes the evidence of low self-confidence that doctors have in their pMSK clinical skills [28], poor performance in clinical practice [30] and a paucity of pMSK teaching known to be delivered in UK medical schools [72]. It was envisaged that improved education and increased awareness of pMSK clinical skills will improve recognition and ultimately the clinical care for children with pMSK disease, given that many children are known to have a delay in access to specialist care [43, 46-48, 51, 53].

Clinical skills are learnt at medical school, with Tomorrow's Doctors (2009) stating that "Medical schools equip medical students with the scientific background and technical skills they need for practice"[85] (http://www.gmc-uk.org/education/undergraduate/tomorrows_doctors_2009.asp). The premise for this study is that pMSK clinical should be introduced at this stage in order that all newly graduated doctors are able to assess children with MSK presentations. This would be best achieved by development of an outcome-based pMSK curriculum, in keeping with current models within undergraduate medical education [85, 117, 119].

3.3 Rationale for study design: Phase 1 - Finding information

The aim of this study was to achieve consensus on content for an undergraduate pMSK curriculum. Following review of the literature, it was clear that there were insufficient published pMSK educational materials to fully inform a curriculum immediately. The requirements therefore were twofold; to initially explore and identify pMSK curriculum content, following which consensus on this content could then be achieved. Different methods were required to achieve these two requirements. Phase one of this study was concerned with identification of pMSK curriculum content and required methods that would allow this topic to be explored with relevant participant groups. This was felt to be best done through focus groups and interviews which would allow qualitative data to be generated from in-depth discussion with a selected group of key participants. The resultant information was then analysed and used to inform phase two of this study in which agreement amongst experts was required on the final curriculum content and was achieved using consensus methodology.

Phase one, therefore, was concerned with generating appropriate data. As discussed in Chapter 1, defining learning outcomes are integral to development of the curriculum. These then inform the other components of the curriculum, such as environment, teaching methods and assessments [117]. Importance needed to be given therefore to the development of these learning outcomes and required more than simply listing topics in pMSK textbooks. pMSK knowledge and skills, teaching content, methods and environment needed to be explored in detail with both teachers and students.

Focus groups are a form of group interview that allow participants to share their own views and hear the views of others, allowing discussion and group interaction, and are widely used across industry and healthcare research [132]. The facilitator of the focus group has an important role in moderating discussion, ensuring all participate and the questions posed to the group are answered, but doing this in a way that encourages interaction and productive discussion [133]. They should allow participants to share ideas in a relaxed environment conducive to group discussion, and are advantageous over individual interviews due to group synergy which may generate new ideas [132, 134]. They consist of 5 – 10 participants, with shared characteristics defined by the researcher and research question [134].

Individual interviews differ from focus groups in that they allow exploration of ideas with one individual in much greater depth, with the interviewer retaining more control over the interview process [135]. Within a semi-structured interview, open-ended questions are used to explore the research question and the participant's beliefs, attitudes and concerns. Compared to focus groups there is greater potential to cover a topic in depth and delve deeper into a participant's responses, and reasoning behind their answers [135]. In this study, Phase 1 was designed to be primarily made up of focus groups, in order to benefit from the group discussion and synergy. However, if representatives from key expert groups were not able to be included in the focus groups as planned, individual interviews would ensure that the views of that specialty were represented. Purposive sampling was used to recruit appropriate participants [136].

3.3.1 Challenges of focus groups and interviews

There are many shared principles in facilitating focus groups and interviews. Similar topic guides can be used in both which gives the facilitator structure to the

questioning.. The need for the facilitator to be sensitive and respectful is also shared between both methods. Other important considerations include comfort of the environment, minimising potential for interruptions, reducing bias from the researcher and preventing sharing personal viewpoints, and avoiding leading questions [133, 137]. Individual interviews result in one participant's views only, while focus groups have the potential of generating a spread of opinion. However, detailed questioning may be used in an interview to explore an answer further.

In moderating focus groups it is essential to ensure all participants contribute and dominant characters do not intimidate or prevent contributions from others with quieter personalities or contrary views; all will have relevant points to make [135]. Allowing participants to discuss issues as a group is the main advantage of focus groups, alongside encouraging the synergy that comes with the group dynamic. This was an important consideration for this group where it was hoped that participants would share their ideas and experiences of pMSK teaching and consider how this should be best delivered. However, the moderator must also ensure the research questions within the topic guide are covered and required the ability to move discussion along when needed without curtailing the emerging group dynamic.

3.3.2 Analysis of focus groups and interviews

Focus groups and interviews generate qualitative data. In this study, this data required appropriate analysis in order to produce suitable content for the next stage of the study: suggested content for a pMSK curriculum. It was anticipated that concepts relating to barriers within pMSK teaching would also emerge from this phase. There are many methods of analysing qualitative data, which in this study refers to the transcripts of focus groups and interviews. Choice of which model of analysis is used depends on the outcome required of the research which in this situation was primarily detection of pMSK curriculum content. Framework analysis [132] was felt to be the most appropriate procedure to adopt. In keeping with other data analysis techniques it allowed straightforward and transparent data management but was also combined with available opportunities for researcher training and support.

Ritchie describes framework analysis as a 'matrix based analytical method' (p219) which uses a 'thematic framework' [132]. In essence, a frame is used to manage the raw data, using concepts and categories to structure a data matrix. The categorisation in this analysis follows a 'deductive' approach in that categories are set early in the

analysis [136], which was appropriate for this study in which the aims and objectives were very clearly defined from the outset and had been informed from pilot work, researcher experience within the field and published literature.

Within framework analysis 'data' from transcript text is inserted into the appropriate category within the matrix, with rows and columns separating discrete data entries both within each transcript and across many. In this way, data can be compared within each episode and across all those needing compared, in this example across all focus groups. A sample matrix is included in Appendix 6. Emergent concepts related to pMSK teaching and proposed curriculum content were the primary focus of analysis for this study, with elements relating to barriers and teaching methods secondary.

3.3.3 Literature Review

During Phase 1 relevant literature was undergoing critical review by the main researcher (SJ) and has been discussed in Chapter 1. Relevant to Phase 1 were any publications with evidence-based proposals for pMSK content within undergraduate teaching in UK medical schools. This proposed content was also included in suggested content going forward to Phase 2 of this study.

3.3.4 Conclusion of Phase 1

The aim of phase 1 was to explore and identify pMSK curriculum content. A literature review contributed any published pMSK educational materials. Focus groups and interviews were conducted with relevant groups: medical students, child health teachers and pMSK experts, with the aim of discussing pMSK teaching. It was anticipated that these groups would generate many ideas on ideal pMSK teaching content which could be categorised using framework analysis to allow emergence of proposed pMSK curriculum content. This then informed the content of learning outcome statements, taking into account any relevant evidence-based proposals from the literature. Acknowledgement of barriers to pMSK teaching raised by students and teachers were considered and may contribute to the structure of learning outcomes. They would also be of importance when developing teaching materials when considering the entire curriculum.

However a curriculum needs to be achievable by learners and reflect the core skills and knowledge that students need to acquire by graduation. This is not defined in the

literature, but experts within the field are likely to share ideas on what this should be. The next step of this study therefore was to seek this expert opinion using consensus methodology in order to define and agree pMSK curriculum content.

3.4 Rationale for study design: Phase 2 - Achieving consensus

In order to move from the ideas generated in Phase 1 and suggested in the literature, an agreement needs to be made by those involved in teaching students on what constitutes ideal core pMSK curriculum content. No such agreement exists already but experts within the field are involved in pMSK teaching already: a method was required to seek this expert knowledge and achieve agreement amongst these experts on what should be taught for all students. In this study this was achieved using consensus methods.

Consensus methods are widely used in healthcare research in order to seek and create agreement from a group of experts that have some knowledge of the field being studied. They have an established use in areas where little published evidence exists [138]. Many guidelines relating to use of medical technology or treatment options have been developed using consensus methodology [139]. This approach has been applied within medical education such as development of curricula [114, 115, 140] or prioritisation of educational needs [141-143]. There is therefore an established track record of consensus methods being used to answer similar research aims as posed here, which contributed to the overall validity of the study design.

The main consensus methods used in healthcare research are the Delphi process and Nominal group technique (NGT) which will be described in this section. Consensus Development Conferences (CDC) are a further form of consensus methodology involving a small group of selected experts who meet within a chaired group process to hear and discuss evidence before reaching a group opinion[144]. They are often determining guidelines or best practice opinions where little scientific evidence exists [145, 146]. CDC use is limited to large institutes such as the United States National Institute for Health (<http://consensus.nih.gov/>), or international professional organisations as they require high levels of cost and organisation. Limitations of this process include the high cost of bringing experts together in this format [138], a small number of experts leading to bias [147] and the lack of anonymity for participants. Within medical education research CDCs feature rarely due to these limitations and this was not felt to be an appropriate method within this study.

Table 2 compares the commonly used consensus methods within healthcare research and shows the overall structure, advantages and disadvantages to each.

Table 2 Comparison of structure, advantages and disadvantages of commonly used consensus methods in healthcare research [138, 139, 144, 147]

	Delphi Process	Nominal Group Technique	Consensus Development Conference
Overview	Iterative process using paper or electronic questionnaires	Structured group meeting with representatives from key stakeholders	Large organisation or government funded conference with small number of 'experts'
Distribution of information	Paper or electronic questionnaires	Pre-meeting information	Pre-arranged 'experts' present their views to participants alongside review of evidence
Participant location	Geographically diverse and not known to each other	Meet in person	Meet in person
Facilitator role	Design and send questionnaire, collate and analyse results	Provide participants with pre-meeting information. Facilitate short focused discussion after points made prior to re-voting	Organisation of experts, evidence and participants. Ensure progress of meeting including final decisions and process of feedback to organisation.
Discussion	No discussion between participants	Short structured discussions to allow explanation of individuals' viewpoints	Open discussion between participants
Anonymity	Participants not known to each other and responses anonymised	Decisions made in private but discussion in person	No anonymity
Financial cost	Low	Medium	High
Overall advantages	Wide range of potential participants Low time commitment for participants. Low cost for organiser Risk of domination by strong opinions minimised	Discussion allows expansion and exploration of viewpoints Likely to achieve consensus Private voting retains individual viewpoint	Discussion allows expansion and exploration of viewpoints Likely to achieve consensus Allows collation of all available evidence and publication of expert opinion Powerful association with large organisations
Overall disadvantages	Cannot guarantee participation/questionnaire return May not achieve consensus	Higher cost than Delphi Discussion may be dominated by strong opinion	High cost and organisation requirement Bias associated with small number of experts coming to consensus

3.4.1 The Delphi Process

The Delphi process is a frequently used consensus method within medical education research [114-116, 141-143, 148]. It is well described in the literature [138, 144, 149-151] and aims to achieve consensus of opinion from a panel of experts in geographically different locations in a series of 'rounds' in the form of questionnaires. Participants are not revealed to each other to preserve inter-participant anonymity, but are known to the researcher. Results from each round are collated and fed back to all participants in the next round of questionnaires. This is termed 'controlled feedback', taking the form of statistical results (e.g. percentage agreement), pictorial results such as bar charts, or modification of statements [138]. By allowing participants to compare their response with others in a structured and objective way may lead to a change in their opinion and ultimately a consensus opinion is reached by repeated rounds. One aim of this technique is to allow the group to share their thoughts without domination by one individual which can happen in a face-to-face group [150].

Before the Delphi process can occur, identification of the panel members is required. They must have 'expert' knowledge of the subject field in order to contribute to the consensus expert opinion [151]. Criteria for 'expert' status must be agreed by the research team and will depend on the subject area and research question, and certainly vary in published studies. Purposive sampling is required here as panel members need knowledge of the subject area in order to contribute effectively to an expert consensus opinion[152]. This potentially introduces a bias as panel members agreeable to participate may have particular interests in the field. This may be offset by increasing the panel size but this is limited by the subject area, time, money and other pragmatic considerations. No specific guidelines on number of participants exist. Table 3 shows the variations in participant number in published studies using the Delphi process within healthcare research.

Table 3 Comparison of published Delphi studies related to curriculum development, with particular reference to panel composition, consensus level and outcome

Subject of Delphi and lead author	Population	Number of participants	Consensus level	Final outcome
Development of a pediatric trauma curriculum Valani	National experts in pediatric trauma, Canada	4 participants in first 2 rounds 11 participants in 1 further round	Not stated	Aims, objectives and skills within 10 domains (full content not listed)
Development of an undergraduate anaesthetic curriculum Rohan	Anaesthetists with teaching interests, Ireland	27 agreed to participate; 100% responded Round 1, 67% Round 2, 59% Round 3	Mean score of 4.0 in a 5 point Likert scale (~80%)	74 items achieved consensus level
Clinical examination of back pain McCarthy	Physiotherapists, UK	30 agreed to participate; 29 responded to Round 1 and 2, 28/30 to Round 3	80%	18 items within 'History' 17 items within 'Physical' examination
Definition of gout flare Taylor	Rheumatologists, worldwide	35 agreed to participate 22/35 responded	Score >7/9 (~78%)	9 elements to allow identification of gout flare
Prioritisation of content: Emergency medicine curriculum Clancy	Emergency medicine consultants, UK	40 agreed to participate; 18/40 returned Round 1, 22/40 returned Round 2	Not stated	6 areas identified as priorities within the curriculum
Skills, attitudes and practices of clinical teachers Yeates	Clinical teachers	47 agreed to participate; 38/47 responded to both rounds	80%	27 items achieved consensus
Learning outcomes for PRHOs Paterson Davenport	PRHOs and trainers, Scotland	74 agreed to participate; 59/74 returned Round 1 52/74 returned Round 2	>3 in a 4 point Likert scale (~75%)	45 learning outcomes classified as 'Priority 1'

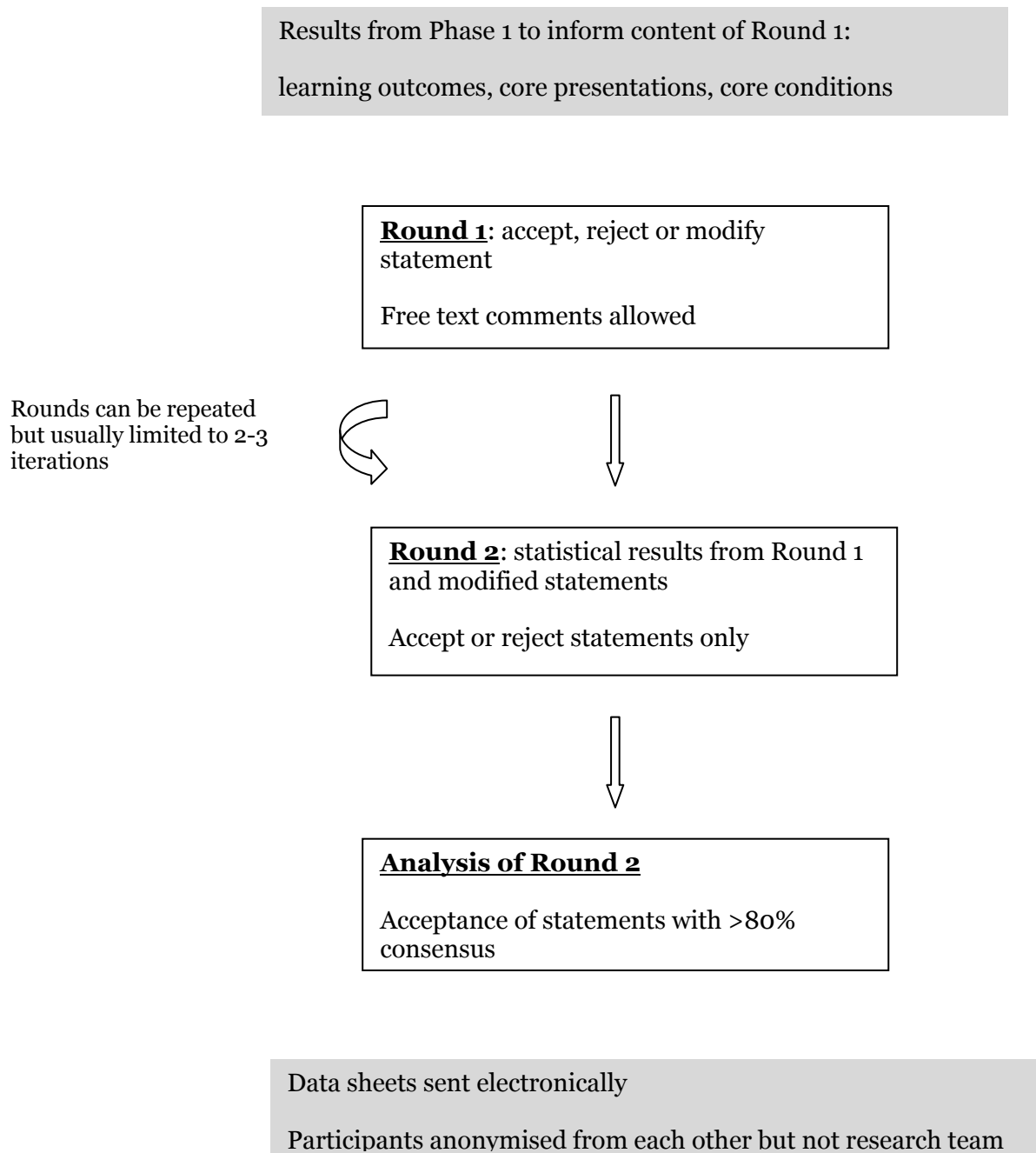
Identification of psoriasis knowledge for medical students Alahlaifi	Dermatologists, trainees, GPs, dermatology nurses and patients with psoriasis, UK	84 participants; 71/84 returned Round 1 Not known if participants contacted prior to study	75%	9 items achieved consensus from both healthcare professionals and patients. Additional 3 items identified by patients related to living with psoriasis
Identification of appropriate task for pre-registration year Stewart	Educational supervisors, UK	96 agreed to participate; 64/96 returned Round 1, 66/96 Round 2	90%	>100 tasks identified; 11 personal abilities as self-management skills
Dermatological content for the undergraduate curriculum Clayton	Multidisciplinary panel: dermatologists, other clinical consultants, nurses and pharmacists, UK	110 sent Round 1; 66/100 returned Round 1, 56/66 returned Round 2 Not known if participants contacted prior to study	5 point Likert scale, consensus at score of 5 (100%)	53 learning outcomes achieved consensus
Defining core psychiatric topics for undergraduate teaching Wilson	Doctors, excluding psychiatrists in Grampian region of Scotland	1345 participants, not contacted prior to study; 408/1345 returned Round 1, 867/1345 returned Round 2	Not stated	30 highest ranking items listed within the paper

An agreement of ‘consensus’ also needs to be discussed within the research team prior to the study [144, 150, 151]. The gold standard for consensus is 100% agreement amongst all participants in relation to a statement. However in situations where the Delphi process is occurring scientific evidence on best outcome is unlikely to be known and differing opinions are usually present. This would make achievement of 100% consensus is difficult to achieve. One way of overcoming this is to perform multiple iterations until statements are suitably modified to be acceptable. However practically this is difficult to perform as response rate is likely to fall with increasing rounds and participants tire of the process [151], and requires significant researcher time. There is acceptance in the literature that the point of consensus is usually lower than 100%, often 75% [148, 149, 151] or 80% [115, 143, 153, 154] (Table 3). For the purposes of this study 80% was chosen as an acceptable consensus end-point for the Delphi process and often quoted in medical education literature.

In order to justify the ‘expert’ nature of the panel, the research team should state and adhere to explicit inclusion and exclusion criteria for panel members, which will contribute to the credibility of findings. For this study, these criteria are listed in Table 4 and discussed in further detail later in this chapter.

A two-round Delphi process was designed for this study (Figure 2).

Figure 2 Overview of Delphi methodology



Responses to statements can be 'ranked', such as that of a Likert scale, in which panel members vote within the spectrum of strongly disagree to strongly agree [155]. Alternatively a simple 'accept or reject' option may be used which is also a ranking, albeit simplified. A criticism of Likert scales is that respondents may choose to 'sit on the fence' and decline to state a strong opinion [156]. In order to attain consensus a clear opinion needs to be stated, and for this study 'accept or reject' was felt to be more appropriate.

A number of modifications to the original Delphi process have been used. This is most common at the Round 1 stage, which traditionally collects qualitative data from the Delphi panel via open-ended questions on the subject area. For this study, this stage was felt to be important to look at in more detail, both for determining the Delphi content and for the wider issues of general curriculum development as discussed earlier. Alternative options to the traditional Round 1 include interviews, focus groups and literature reviews [150, 151]. Focus groups and interviews could be seen as superior to literature review alone as they are less reliant on the researcher's interpretation and involve expert opinion. Further advantages to exploring qualitative data in focus groups or interviews include widening the expert pool and participant involvement, the potential for deeper exploration of issues than a questionnaire might allow, and minimising the rounds of questionnaires needed in the Delphi process. For these reasons focus groups and interviews were chosen to replace the traditional Round 1, leaving a two-round Delphi in which to achieve consensus.

At the conclusion of this Delphi process it was anticipated that the learning outcome statements for a pMSK curriculum would have been developed using a well-established and rigorous method appropriate for medical education research.

However, it was felt important to ensure as rigorous a process was attached to both acceptance and rejection of statements, and a further stage was needed in the study to review the Delphi results and allow discussion of those statements with a lower consensus level. The Nominal Group Technique (NGT) was felt to offer the best way of achieving this goal and completion of the consensus process.

3.4.2 Nominal Group Technique

The final part of Phase 1 involved the use of NGT to review the results of the Delphi process (Figure 1). This contributed to content validity of the final curriculum results. Methods used in published Delphi studies include consensus meetings, focus groups and pilot testing of the final product [149-151], all of which allowed discussion of results and review of the final outcome. This stage allowed the opportunity to include further statements and was not designed to reduce or change the outcome from the Delphi process.

For this study, it was felt that the rigorous conduct of the Delphi process gave validity to the final statements achieving 80% consensus. These statements, therefore, reflected the expert panel's shared opinion core pMSK curriculum content. To discuss these agreed statements again, or indeed to change them after this stage, would undermine the consensus approach and detract from the rigorous process.

However, further consideration was needed for those statements with a lower percentage agreement. While it was presumed that a high level of consensus correlated with the expert panel having a shared understanding of the statement content, the converse may not be true; that is there may be a lack of clarity leading to differences in interpretation. It was felt particularly important that there was an opportunity for the principles behind the statement content to be explored in a structured way by an appropriate panel. For example, a statement relating to paediatric orthopaedic content may be felt to be irrelevant to a paediatrician. Further explanation and discussion may reveal the importance of prompt diagnosis of this condition or relevance to developmental changes which would make this statement more important.

For this study, a modified NGT was felt to be appropriate, allowing a consensus opinion to be generated on the final curriculum content in a structured and facilitated format [138, 139]. This is a face-to-face meeting allowing discussion and the opportunity for individuals to explain their decision making process. It has been used extensively in healthcare research and within medical education areas such as curriculum evaluation [157], assessment tool development [158] and development of competencies [159, 160]. It has been alongside other consensus methods such as the Delphi to provide a 'check' on the Delphi results and provide content validity [159].

The structure of the NGT should follow certain principles [138, 144]:

- A trained facilitator should lead the group and should be ‘expert’ or ‘credible non-expert’.
- Identification of group members and invitation to attend and participate, using purposive sampling if appropriate
- Individuals should decide in private their opinion and feed this back in turn to the facilitator
- Facilitated and structured discussion then follows which provides an opportunity to clarify and expand on reasoning
- Participants subsequently vote again in the light of this discussion
- Further rounds of discussion and re-voting take place until consensus has been reached.

Two studies have compared the Delphi process and NGT as consensus methods [161, 162]. The setting for both studies was in primary care and randomised participants to either NGT meeting or Delphi questionnaires, and compared the findings. Kadam’s study found no difference between the two study groups in their findings, or statistical differences between the groups[162]. In the other study, Hutchings looked at three different conditions and their treatment in primary care [161]. Findings in this population reliability was greater in the Delphi process when looking at between-group agreement at each round, which they feel may be attributable to larger group size and anonymity to others’ responses. However, findings from the NGT were more in agreement with evidence guidelines for best care. It is hard to generalise from this study as the findings are specific to the participants and the subject. However, the authors do comment that the two methods could be used in conjunction with each other to achieve best consensus.

The NGT is often used to rank items in order of importance, with discussion used to inform re-ranking in subsequent rounds [138]. For this study the NGT was used to achieve the final consensus set-point following the Delphi process and the technique was therefore modified; instead of ranking the items for discussion participants would be asked to vote for the consensus level above which all learning outcomes should be accepted. This would mean that points below the 80% agreement were discussed and voted on before agreeing the final curriculum. The benefit of the NGT was to allow discussion, with the opportunity to offer reasoning and explanation behind a statement’s meaning. With different expert groups participating, this would allow the opportunity to defend specialty-specific points in a structured fashion. This differs from a straightforward discussion group as participants are still able to make

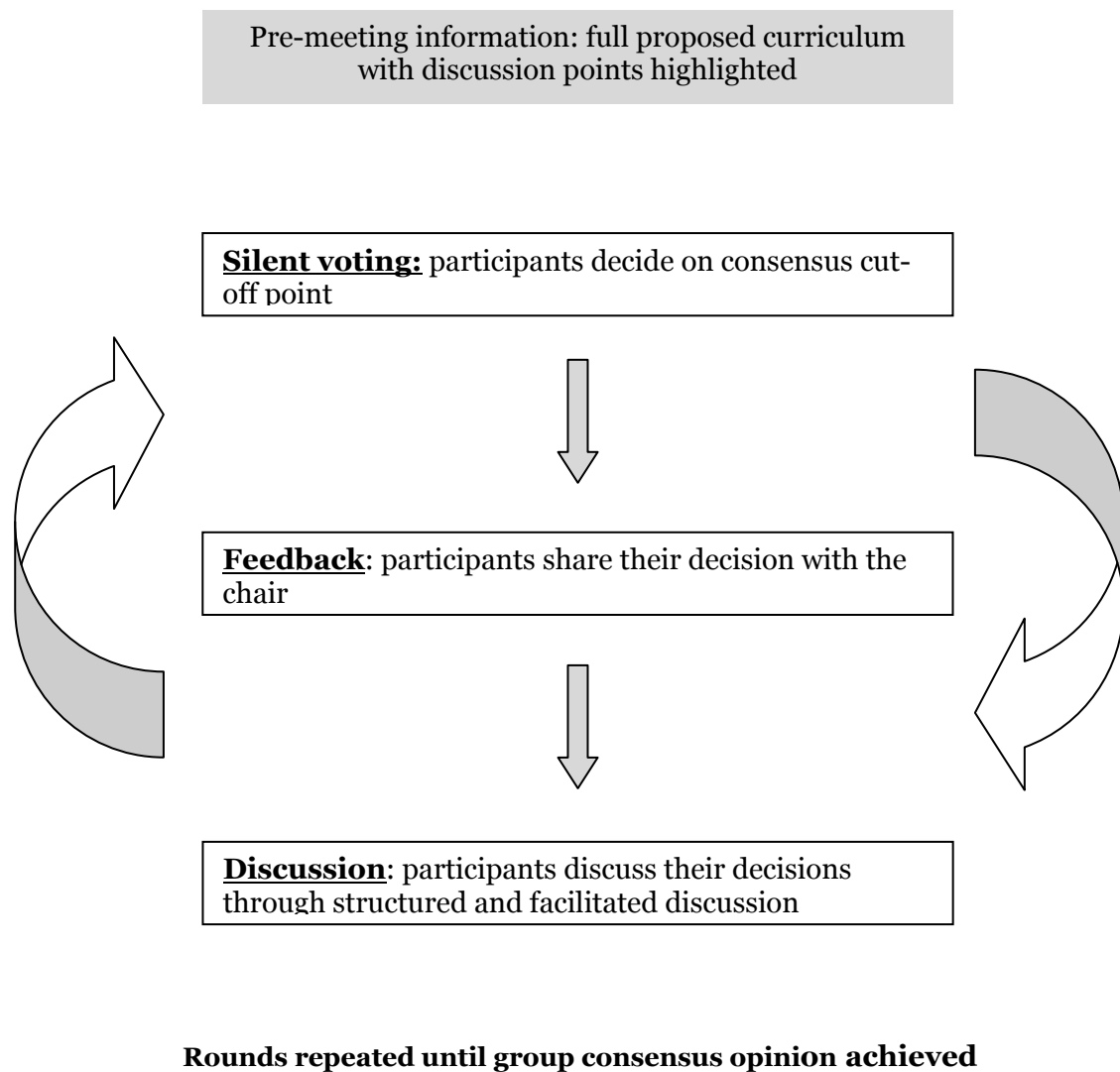
individual decisions, with the facilitator structuring discussion and feedback in order to achieve consensus from the group.

In order to keep this meeting linked to the Delphi process, and to maintain the structure of consensus, it was felt appropriate to discuss the statements in the order of percentage agreement. In doing this, participants would be asked to set the level of consensus, and all statements above this level would be included in the final curriculum content. In essence therefore the NGT was serving two purposes: allowing discussion and clarification of the contentious points for which the Delphi panel could not achieve consensus, and providing an external review of the consensus set-point. This was therefore an important final step.

For practical reasons this meeting was planned to be held in Newcastle. It was agreed by the research team that certain principles should be maintained in this process. Representation from all expert groups was essential (Table 1). The aim of the meeting was to decide on where final consensus should be set, with the opportunity for short facilitated discussion if participants differed in opinion on where the consensus level should be.

The format proposed can be seen in Figure 3. This process concluded with a list of pMSK learning outcomes from medical students derived from evidence and expert consensus from which a pMSK curriculum could be developed.

Figure 3 Structure of Nominal Group Technique



3.4 Rationale for overall research design

This study combines three research methods: focus groups and interviews, Delphi process and nominal group technique. It was felt that this combination was a more rigorous way of curriculum development than using one method alone. The main focus of the overall study was the Delphi process as this produced the consensus-derived curriculum; focus groups provided suggested content and the nominal group technique provided a check and validation on the results.

Focus groups and interviews in Phase 1 provided an opportunity to gather qualitative data on proposed curriculum content. In the traditional Delphi process this is done by asking the panel a small number of open-ended questions to generate written free text. This was performed in the studies to determine anaesthetic[115] and psychiatric [114] curricula. However, this leads to a three round Delphi process and responses are in the written format only, with no opportunity for panel members to discuss or elaborate on their statements. Focus groups are an accepted alternate way of generating content or the Delphi process from appropriate participants [149, 151, 153] and, in this study, also allowed discussion on other curriculum content such as teaching methods which would inform future implementation. These methods do not provide consensus however, with the analysis of both focus groups and interviews leading to emergent themes and concepts only. The benefit of this study design was that these were able to be included in the Delphi study for consideration by the expert panel.

Setting the final consensus level of the Delphi is a challenge of this methodology [150, 151]. While a consensus level is usually set at the beginning of the process, this is usually an arbitrary decision by the research team and may not necessarily reflect the true findings of the study. The Nominal Group technique in this study was designed to offer an element of content validation to the Delphi results and provided a structured discussion forum in order to set the final consensus point. In order to adhere to the rigorous format of the Delphi process, the NGT did not offer the opportunity to change or remove elements that the Delphi panel had agreed on. By allowing this face-to-face discussion process, representatives from the identified expert groups were able to provide justification for the inclusion of items that they felt were important for their specialty. This process of clarification and discussion is not as easy to achieve in a remote Delphi process. The alternative to the NGT would have been to repeat rounds of the Delphi until no changes in responses were noted. However, it is recognised that responder fatigue occurs with increasing rounds of the

Delphi, or indeed any questionnaire, and a lower response rate has the potential to lessen the validity of results. Additionally, if an item achieves low consensus because of ambiguity or lack of understanding by the panel, there is no opportunity in repeated Delphi rounds to seek clarification. The NGT, therefore, allowed structured discussion format with representatives from all stakeholder groups in order to achieve consensus but in a way which did not detract from the rigorous nature of the Delphi as the content was unchanged.

The overall combination of these methods was beneficial to this study. Participation of different pMSK and child health experts at all stages contributed to the generalisability of the results. Use of different methods to look at the same subject can be seen as a form of triangulation which also contributes to the validity of the study's results [152, 155, 163].

3.5 Maintaining rigour

It was important to consider how to maintain methodological rigour throughout this study. Initial steps in this involved clearly defining the aims and objectives and choosing methods that would allow these to be achieved. The final result should be as 'true' as possible and ways of maintaining rigour relate to minimising bias, maintaining researcher objectivity, while ensuring generalisability and overall validity [136, 163].

Ensuring validity of the data is important and, for the purposes of this study, was considered in the following ways [155].

- External validity is concerned with the generalisability of the findings to wider populations
- Internal validity looks at ensuring that the findings are 'true' to the subject being studied

Across both phases of the study purposive sampling was used [136, 152, 163]. This was important for external validity and minimising bias that may come with limited specialty input. By ensuring all relevant groups were represented and choosing more than one geographical location findings were more generalisable to all UK medical schools which was an important remit of this study.

When considering the study design and methods used, these were in line with other published studies and managed according to best practice. For example, in Phase 1, focus groups were facilitated by the same trained researcher (SJ), using the same topic guide. Principles of running good focus groups were followed as explained earlier (section 3.3.1). Phase 2 of this study involved a Delphi process and Nominal Group Technique. Clearly stated structures for these methods have been stated in the literature [138, 141, 150] and followed in this study. Explicit reasons for any amendments to these published structures were given. For example, within the Delphi process, Round 1 traditionally involved asking the panel open-ended questions to generate data which would inform the subsequent data sheets. In this study, focus groups and interviews had a similar purpose in generating data, but within a format that allowed exploration and discussion. While a deviation from the normal method, it is a modification that is accepted in practice [149, 151] and is still true to the original goal of the Round 1 Delphi of generating data from relevant experts. Other principles of the Delphi process were followed which contributed to the overall validity of the research findings such as use of a well-defined expert panel and setting of an appropriate consensus level.

Data handling and collection was an important consideration for the reliability of this study's findings. The main researcher (SJ) was responsible for collection of the data, and subsequent management. In Phase 1 this related to engagement with the transcripts, construction of the data matrices and categorisation of the focus groups findings [132]. Within the data matrices, the origin of each entry was clearly entered in relation to the relevant focus group or interview transcript. In turn, proposed items for content in Phase 2 could be tracked to the data matrix and analytical framework. Emphasis was given to systematic and thorough data analysis with repeated review and critique of findings [164]. By doing this, another researcher should be able to look at the data, know its origin and assure themselves that this was a 'true' finding. However, involvement of more than one researcher would have shown inter-rater reliability, and may have reduced the potential bias that may come with one researcher [155].

Data management was again important in Phase 2. For the Round 1 questionnaire all content could be tracked to suggestions from focus groups and interviews (Table 9) or published literature. Maintenance of a structured and transparent approach to analysis of Round 1 was then required. This was achieved by following recently published 'rules for managing panel responses' [143] and referred particularly to the free text comments and modifications suggested by panel members. Within this

study, these rules ensure all modifications and comments were accounted for. Those expressing similar concepts were combined, those expressing new content were included in the next round, and suggestions felt to be irrelevant to the aims and objectives of the study were discussed by the research team before being rejected. This structure was followed in this study and allowed all modifications suggested in Round 1 to be tracked in detail, enabling any other researcher to readily see the outcome of all modifications suggested (Appendix 8).

Objectivity relates to minimising the impact the researcher has on the phenomenon being studied [165]. Within this study this was primarily related to impartiality of the research team. The main researcher and extended research team all had knowledge and experience within pMSK medicine and pMSK education, and have previously been involved in pMSK educational research [28, 72, 90] and Delphi studies [141, 143]. This is likely to have influenced the overall study design, with a predisposition to using methods they are experienced with. All within the research team were likely have pre-existing ideas about the outcome of this study which may have introduced bias to their interpretation of the study results. In order to overcome this, ideas on pMSK content were generated from a range of professionals and students in different locations during Phase 1 of this study. However, the study participants were all aware of the background of the main researcher (SJ), who conducted the focus groups, which may have influenced their contributions and discussions, particularly if their opinions were likely to disagree with the research concept. Objectivity was maintained where possible by remaining impartial while conducting the focus groups and interviews, by asking open questions, and allowing the participants to generate discussion on the areas they felt were important.

Alongside these criticisms, the background of the researcher could also be seen as positive for this study. When recruiting participants, her position within pMSK medicine contributed to her credibility as a researcher in this field. During data analysis, knowledge and experience within pMSK education was essential in order to understand contributions from study participants. Similarly, the experience of the extended research team also had a positive impact on this study, as the methods were conducted in a rigorous manner with appropriate supervision.

In summary, key principles that relate to rigour ran throughout this study. A clearly structured study design with explicitly stated methods contributed to the overall validity. Impartiality by the research team contributed to objectivity while reliability was maintained by consistent and robust data collection and management. By

identifying key groups to be included in this study, and the use of purposive sampling to ensure their participation, generalisability of the findings was addressed.

3.6 Study population and identification of research participants

A joint publication from the General Medical Council (GMC) and Postgraduate Medical Education and Training Board (PMETB) on the 'Principles of good medical education' gives guidance on participation:

'Learning outcomes should be developed jointly within the specialty or discipline concerned and, wherever possible, with students, trainees, patients, the public and colleagues from other professions'

Within this study, participants from the appropriate specialty and discipline (consultants within pMSK medicine or child health) and medical students were involved. Patients and trainee doctors were not included as participants.

While patients have an important contribution within specific disease education, they were not felt to be appropriate within this methodology. In published studies on undergraduate medical curricula (Table 3), only one study included patient contribution in order to determine medical student knowledge on psoriasis [148]. In those studies determining knowledge over a whole subject area such as psychiatry, dermatology or anaesthetics [114-116], participants were healthcare professionals only. Education in a particular subject area requires knowledge of many different aspects of medicine and the ways in which these are integrated. This differs from specific disease education where an understanding of the patient perspective is of utmost importance. As this study focussed on determining the general curriculum content for pMSK medicine, it was not disease specific and indeed identification of pMSK diseases that medical students should be aware of was a planned outcome. To have included patients with specific pMSK diseases such as JIA from the outset would have introduced bias to those diseases and was therefore not deemed appropriate. Patient involvement is likely to be of importance in the next stage of this study when planning implementation of the curriculum

A further population that were considered as study participants were newly graduated doctors. As previously stated, doctors within the UK Foundation

programme [86] are often involved in the care of children within paediatrics, primary care or emergency medicine. This group could have used their experience to determine the level of knowledge necessary for the newly graduated doctor. However, in this study they were not included as they were not ‘experts’ within child health or pMSK medicine or ‘stakeholders’ within undergraduate medicine as medical students are. Again, this population should be involved in any implementation study and may provide a useful critique of the curriculum when considering validation.

Allied health professionals have a strong presence in pMSK medicine; nursing staff, physiotherapists and occupational therapists. They may be involved in undergraduate teaching alongside the clinical team, and it was therefore felt to be appropriate to include them in Phase 1 within pMSK expert focus groups. However, as the majority of child health teaching is delivered by consultant and primary care doctors[72], allied health professional do not meet the ‘expert’ criteria of the Delphi panel and were therefore not included at this stage.

A number of key groups were identified to be included in this study. The idea for this study originated from pMSK medicine ‘experts’ (paediatric orthopaedics and paediatric rheumatology) who care for children with musculoskeletal disease and therefore have a vested interest in ensuring that adequate and appropriate pMSK education is delivered. The support through the professional organisations of the British Society for Paediatric and Adolescent Rheumatology (BSPAR) and the British Society for Children’s Orthopaedic Surgeons (BSCOS) was present throughout the study design and set up.

However, it would be insufficient to simply focus this study on pMSK experts alone. Within the UK National Health Service (NHS), a child with a pMSK problem will present first to primary care or emergency medicine departments. These doctors need to use their clinical skills and judgement to decide on the underlying cause of the child’s presentation and need for ongoing care; reassurance, review or referral to general paediatrics or pMSK experts. For a child with pMSK disease such as JIA, this could mean being seen by both their primary care doctor and a general paediatrician before referral to paediatric rheumatology, where specialist care could be given. The length of time spent in this pathway may be contributory to the known delay in access to care seen for children with JIA [43, 46-48].

The views of these populations were therefore important: primary care, emergency medicine and general paediatrics (referred to as ‘generalists’). They provided clinical

perspective on the core pMSK skills and knowledge that would allow newly graduated doctors to assess children appropriately and adequately. With the introduction of the Foundation programme (www.foundationprogramme.nhs.uk), this is increasingly important as more doctors are exposed to these specialties early in their medical career.

Alongside this, educational perspective was also required to reflect the needs of those delivering and receiving the curriculum. It is known that child health teaching is delivered within the primary care and hospital child health settings [72] and so teachers from these settings were recruited. Representatives included those from the ‘generalists’ and pMSK ‘experts’ groups, with further input from those with special interests in paediatric education.

Relevant participants for this study therefore are pMSK ‘experts’ (paediatric rheumatology and paediatric orthopaedics), primary care doctors, general paediatricians, and those involved in paediatric education. Student participation was included in Phase 1. The role of these groups is discussed in further detail below.

3.6.1 The roles of study participants

Phase 1 focussed on generating ideas for curriculum content, to be used as proposed learning outcomes. Medical students are the recipients of an undergraduate curriculum and it was important to explore their views on curriculum content, alongside other aspects of the curriculum such as learning environments and teaching methods. Focus groups also provided an opportunity for students to discuss their perceived barriers to learning about pMSK medicine and suggestions on how to overcome these. Their views on learning outcomes may differ from that of their teachers [166], as recently explored during development of an emergency medicine curriculum, [167]. In this study, students (termed ‘novices’) desired strict outcomes that clearly defined what they should learn. Senior doctors (‘experts’) had more complex views of outcomes, based on intuition and their experience, with less strictly defined boundaries. Learning outcomes and the general curriculum need to encompass both of these concepts; students require direction on what they should learn but there should be some flexibility within this to reflect the clinical teaching environment and opportunistic nature of many clinical encounters between teacher and student.

Phase 2 of this study relied on 'expert' view in keeping with consensus methodology [149, 151]. Students are not experts in pMSK medicine, primary care, child health or education, and were therefore not included at this stage.

Primary care doctors are involved in delivering child health teaching at UK medical schools [72]. Their representation in this study therefore contributed both clinical and educational perspectives. The role of primary care in assessment of children with pMSK presentations has been discussed above, and they have an important role as 'gatekeepers' to hospital referrals, which includes pMSK experts. Many doctors enter primary care directly from the Foundation programme and may not work at all within hospital paediatrics[86]; their only child health clinical skills teaching will have occurred at medical school. pMSK educational content at undergraduate level needs to be appropriate and reflective of their needs in order to allow them to effectively assess children with pMSK presentations.

Within the child health hospital setting, paediatric clinical skills are taught by clinical staff, regardless of their background. A specialist in gastroenterology would be expected to teach respiratory examination, and the converse also applies. pMSK teaching would be expected to be delivered by any teacher therefore, and not limited to pMSK experts. General paediatricians, and those with particular educational interests, were important to include in this study, and their input necessary to produce a realistic curriculum.

From a clinical perspective, general paediatricians are often involved in the management of children with pMSK presentations and are a part of the referral pathway for children with pMSK diseases. However, within the general paediatric spectrum some groups will have more significance for pMSK medicine than others due to the overlap of pMSK presentations. For example, a child with difficulty walking may be seen within paediatric neurology, or referred for a developmental review. It was hoped that by including a spectrum of paediatric specialists the views of these groups will be represented.

The populations identified to contribute to this study were the following:

- Medical students as key stakeholders within undergraduate education
- pMSK 'experts' within paediatric rheumatology and orthopaedics.
- General paediatricians to include specialists within neurology, development and community.
- Paediatricians with specific role in teaching

- Primary care doctors

Inclusion and exclusion criteria for all stages of this study are listed in Table 4.

Table 4 Inclusion and exclusion criteria for participants throughout all study methods

	Inclusion criteria	Exclusion criteria
Focus groups with medical students	Final year medical student Experience of child health teaching	Medical student below final year No experience of child health teaching
Focus groups with consultants	Employed within NHS or UK university Consultant status GP principal status Allied health professional within pMSK medicine Final year Specialist Registrar (SpR) only if involved with undergraduate teaching Specialised within pMSK medicine, emergency medicine, paediatrics or primary care Involvement with undergraduate teaching	SpR below final year stage No experience of undergraduate teaching Specialty outwith those stated in inclusion criteria
Interviews	Consultant within specialty not able to be included within focus groups	
Delphi study	Employed within NHS or UK university Consultant status GP principal status Final year Specialist Registrar (SpR) only if involved with undergraduate teaching Specialised within pMSK medicine, emergency medicine, paediatrics or primary care Involvement with undergraduate teaching	SpR below final year stage No experience of undergraduate teaching Specialty outwith those stated in inclusion criteria Involvement within focus group or interview
Nominal Group technique	Employed within NHS or UK university Consultant status GP principal status Final year Specialist Registrar (SpR) only if involved with undergraduate teaching Specialised within pMSK medicine, emergency medicine, paediatrics or primary care Involvement with undergraduate teaching	SpR below final year stage No experience of undergraduate teaching Involvement within focus groups, interview or Delphi study

3.6.2 Identification of participants

Sampling for study participants was important to consider. Random sampling of medical students and clinicians would potentially miss many of the targeted populations listed above and was not therefore appropriate for this study design. The nature of consensus methodology require participants to have expert knowledge within the study area, which within this study this refers to pMSK medicine, child health teaching, or general child health skills.

Non-probability sampling allows the research team to identify relevant study populations and key individuals with significant knowledge or standing for participation [136]. Purposive sampling is a variation of this and allows for variation of sampling as the study progresses [164]. Key populations or individuals may be identified as having appropriate knowledge or experience and invited to participate. As data is analysed other informants may be deemed important to enrol in the study, for example in this study certain groups may not be represented in the focus groups and individual interviews can then be arranged. Purposive sampling was used throughout this study as it ensured representation of all participant groups at all stages.

3.7 Detail of methods: Phase 1 - Finding information

All focus groups, interviews and analysis were conducted by the main researcher (SJ). Training in running focus groups was provided by Newcastle University and training in qualitative data analysis by the National Centre for Social Research.

3.7.1 Focus Groups

The primary method within Phase 1 was focus groups with medical students and clinicians. It was decided by the research team to hold these in three locations: Newcastle University, University of Glasgow and University of Birmingham. The University of Glasgow offers a Problem-based learning curriculum with the other two universities offering an integrated, systems-based curriculum.

Newcastle University was the base for this project and therefore an obvious choice for one location. As the home base, planning and organisation was straightforward and no further ethical or Research and Development (R&D) approval was required.

It was felt to be important the research was not based in Newcastle alone in order to improve the generalisability of the findings, and to minimise the bias that may come

with basing the study on one location only. A number of MSK educational initiatives have been developed in Newcastle [90, 96], which may make Newcastle more proactive in MSK teaching, compared to other universities. As the research team is already involved in undergraduate pMSK teaching (SJ, HF) this could potentially also affect the outcomes of this focus groups. However the timing of the focus group was chosen in order to precede any formal teaching with which the researchers may be involved.

Other cities were chosen due to differences within medical school curricula, and contacts within each that would allow facilitation of organisation. R&D approval within each trust was applied for successfully. A lead pMSK 'expert' in each location helped with identification of participants and invitation to attend the groups.

Informed consent was obtained from all participants. All groups were recorded with additional notes taken at the time of the group. Recordings were transcribed, and then stored in a locked cupboard until completion of the research. Transcripts were anonymised, with participants identified by number and profession only. No names or identifiable details contained within the transcript or analysis documentation. By doing this, participants could be reassured that their contribution would be treated confidentially.

A topic guide was used in all groups to structure discussion (Figure 4). This is recognised as providing a structure for discussion and links between topics [135]. Important points to explore ('probes') were important to include. This guide differed between consultant and students only in their experiences of being taught (students) versus running teaching (consultants). Construction of the topic guide came from the aims of the study which covered current pMSK teaching, core content for an undergraduate pMSK syllabus, and suggested teaching methods with recommended teaching aids.

A pilot focus group was held with medical students at Newcastle University which allowed piloting of the topic guide, facilitation and recording equipment. The same recruitment, information and consent processes were used as for other planned groups. This pilot led to some modification of the topic guide: open questions were used at the beginning ('tell me about your pMSK teaching so far') with more closed and focused questions in later sections ('what do you think medical students need to know about pMSK medicine by graduation'). Facilitation skills learned during this

pilot included the need to establish all participants' viewpoints and importance of positioning to allow good group dynamics.

Appropriate date, time and hospital location for each group was identified by the researcher in conjunction with student administrators for each site and a request for participation sent to all final year medical students on paediatric placements at that hospital. Incentive in the form of lunch was offered, as per ethical approval, and general information about the study was circulated. Attendance at the group was voluntary and confidentiality assured.

An ideal group was deemed to consist of between five and eight students with one hour of uninterrupted time set aside. All groups were audio-recorded (Olympus digital voice recorder DS-50) and additional field notes taken by the facilitator (SJ). After the first focus group the recording was reviewed and any new issues fed in to the following group.

3.7.2 Individual interviews

Participants for the interviews were identified while Phase 1 was ongoing to ensure adequate representation of all groups. Purposive sampling was used to identify participants within the appropriate fields. Invitations to participate were sent by email with a brief outline of the study. If agreeable, the Participant Information Leaflet (PIL) was sent prior to the arranged interview date (Appendix 1).

Interviews were held in the participants' work-place and were audio-taped with consent. The interview was structured similarly to the focus groups with interviewees being asked about their experiences within pMSK teaching, core content for an undergraduate pMSK syllabus, and suggested teaching methods with recommended teaching aids. Interviews allowed more detailed discussion where appropriate; this depended on the interviewees' area of interest.

Informed consent was obtained from all participants. Additional notes were taken during the interview alongside the audio-recording. Recordings were transcribed, and then stored in a locked cupboard until completion of the research. Transcripts were anonymised, with participants identified by number and profession only. No names or identifiable details contained within the transcript or analysis documentation. By doing this, participants could be reassured that their contribution would be treated confidentially.

3.7.3 Analysis of interviews and focus groups

Framework analysis was used to define content for learning outcomes within pMSK medicine. Categories for the data matrix were required to allow data to be inserted appropriately and compared. These categories were informed by the research aims (Chapter 2) and topic guide (Figure 4) and were refined after the first focus group. The main outcome for this data analysis was to define proposed pMSK teaching content, with additional outcomes being identification of barriers to pMSK teaching that may inform teaching resources and curriculum content, and ideal teaching methods. Categories used in all groups are listed in Table 5 with the full data matrix included in Appendix 6.

Table 5 Categories for data matrices used in accordance with framework analysis in Phase 1, showing the categories within which focus group and interview data were coded.

Student focus groups	Consultant focus groups and interviews
Demographic data	Demographic data
Current pMSK teaching Experience to date Perception of pMSK teaching Barriers to learning pMSK Experiences of adult MSK teaching Others and barriers to general paediatric teaching	Own experiences of received pMSK teaching Perception of pMSK clinical skills performed in clinical practice
Experiences of teaching Good experiences – teachers Good experiences – methods Bad experiences – teachers Bad experiences – methods Other	Barriers to pMSK clinical skills in clinical practice General paediatric teaching
Proposed pMSK teaching Content Teaching methods Teaching materials Other	Current pMSK teaching What they teach at present Perception of current pMSK teaching Barriers to current pMSK teaching
	Proposed pMSK teaching Content Teaching methods Teaching materials

3.7.4 Literature Review

A critical review of the literature was undertaken within the wider remit of this study. For the purposes of Phase 1, relevant publications were those relating to undergraduate pMSK teaching, ideally within the UK. Relevant papers underwent critical analysis including review of the methodology and the publication's findings in relation to this study. If pMSK teaching content was suggested this was included alongside proposed content from focus groups and interviews.

3.7.5 Conclusion of Phase 1

The primary outcome of Phase 1 was proposed content for a pMSK curriculum for medical students derived from qualitative data within focus groups and interviews and evidence from the literature. This informed the development of learning outcomes which would comprise the content of the Delphi process in the next stage of this study.

3.8 Detail of Methods: Phase 2 Seeking consensus - Delphi process

As described earlier, the Delphi process was planned to be a two-stage iterative process using a remote panel of 'experts' to achieve consensus on pMSK curriculum content. Information from Phase 1 (focus groups, interviews and evidence from the literature) provided content for the Round 1 questionnaire. It was hoped to complete both rounds before the summer, when it was anticipated that many consultants would be away. Before running the Delphi process key stages were essential: identification of panel members and formation of the Round 1 questionnaire.

3.8.1 Identification of panel members

The Delphi process relied on panel members who have some prior knowledge of the topic [149] and were agreeable to take part in the timescale required. Inclusion and exclusion criteria for panel members are listed in Table 4.

Awareness of the need for participants was raised at all local and national pMSK teaching events conducted by the research team from the start of this research study with several interested clinicians volunteering to take part. UK-wide representation was desired where possible. Panel members were identified in different ways using purposive sampling:

- Paediatric orthopaedics

Email invitation sent via the President of BSCOS with information about the project and requirements for the Delphi process. Interview candidates from Phase 1 were excluded at this stage. A further email invitation was sent to the Scottish paediatric orthopaedic society requesting participation from their members.

- Paediatric rheumatology

Members of BSPAR that had not previously taken part in this research project or other educational research projects running concurrently were identified and email invitations sent individually. Both paediatric rheumatologists and paediatricians with special interest in paediatric rheumatology were invited to participate

- Paediatrics

Consultants that had previously expressed an interest in involvement in this project were invited to participate in this stage by personal email. To ensure relevant specialties were represented, several individuals known to have expertise in these fields were contacted and invited to participate.

- Paediatrics with educational interest

Many individuals involved in paediatric education were already known to the research team. Individuals were therefore approached by individual email invitation with information about the research project.

- Primary care

Email invitations were sent to the members of the Primary Care Rheumatology group and the lead primary care tutors for Newcastle University. Several primary care doctors who had previously expressed an interest in participating in this research project and were invited to participate by personal email.

Email invitations contained a brief outline of the research project and information about the requirements of the Delphi process. Confidentiality was assured at this stage. If agreeable, the participant information leaflet (Appendix 3) was sent with the next email along with more detailed information about the Delphi such as timescale and format. All those that agreed to take part were considered part of the Delphi panel.

3.8.2 Formation of Round 1 questionnaire

At the end of Phase 1 a number of items were identified as proposed pMSK teaching content for medical students (Table 9). A logical way to group these was under the clinical skills expected of medical students: history taking, examination, investigations and management. As discussed earlier (section 3.4) the overall aim was to produce curriculum content in the form of learning outcomes that the student should achieve before completion of their training; within the curriculum these drive the educational delivery, content, assessments and evaluations [117, 119].

These outcomes were therefore developed by the main researcher (SJ), with guidance and review by the research team. Content from phase one formed the basis of the outcomes, with emphasis on skills expected for undergraduate students. It was anticipated that during Round 1 of the Delphi process the 'level' of skill could be modified by the panel as they felt appropriate.

Optimum and timely return rate is important in this process and indeed the Delphi process relies on responses from the first round to inform content of the second. Response rate has been highlighted as a potential problem area when conducting a Delphi process [151]. Various strategies were employed in this study to improve response rate. All participants were contacted in advance of the Delphi process with personalised invitations and study information with invitations sent electronically from a Newcastle University email address [168] [169]. Confidentiality was assured and attempts were made to keep the questionnaire as concise as possible [169, 170]. Monetary incentives have also been recognised as improving response rates [169] but were not considered to be ethical or appropriate for this project.

Consideration was given to a web-based survey as opposed to mail based. These are becoming increasingly common with the advent of user-friendly software such as 'Survey monkey' (<http://www.surveymonkey.com>). However this was not included in the original project grant funded proposal as at that time the researcher and team were not sufficiently trained in web-based delivery. However, adjustments were made to the survey to allow it to be edited on-screen if participants wished to do this rather than send by post or fax. As all communication with participants had been by email it was decided to send the survey electronically, with clear instructions on returning the questionnaire given on initial covering email, in the introductory paragraph and on page footers. Options were given to return by mail, post or fax. A Cochrane review of electronic questionnaires [169] identified several factors to improve response rate. This was published after the survey had been sent but on review many of these

strategies had been adopted: use of a white background, personalisation, including 'survey' in email header and use of a deadline.

The Round 1 questionnaire as designed by the research team then underwent pre-testing. Participants for this were identified as non-participants in the Delphi process but with understanding of the study aims and clinical background. These (n=5) came from within paediatric rheumatology, adolescent rheumatology, paediatrics and primary care and gave useful information on comprehension of statements, layout and time to complete. Feedback was incorporated into the final version and led to minor changes in a small number of statements; two were felt to state similar concepts and one was felt to be ambiguous. One statement was moved from the history-taking to the examination section. In terms of layout a further explanatory statement was added and the format of a table was changed to make it more user-friendly. Participants at this stage took an average of 10 minutes to complete the questionnaire, and this information was included with the cover letter accompanying Round 1. This pretesting was a useful process in understanding how participants would complete the data sheet with the aim of improving completion and return rate [170].

The Round 1 questionnaire was then sent to all clinicians that had agreed to participate in this Delphi process (Appendix 7). This was accompanied by a personalised cover letter containing a further brief overview of the study and reminder of the aims of the study. Their confidentiality was assured and all were asked to complete consent forms (Appendix 5). Participants were asked to return their completed Round 1 questionnaire by post, email or fax within a 2 week period.

3.8.3 Analysis of Round 1 responses

All responses to Round 1 were returned to the main research team at Newcastle University. Results were entered onto a database using the SPSS statistical software package with participants identified by number only. For each statement the percentage of participants that accepted, rejected or modified the statement was recorded. All modifications were entered onto a separate word document and linked to the respondent's identifying number (Appendix 8). It was important to be able to account for every modification or new suggestions, and a proposed set of 'Delphi rules for managing Delphi responses' [143] were used in this study. This contributed to clear data management, as a clear output could be attached to each modification. In essence, modifications and suggestions were managed in order to retain the

overall concept but reduce repetition, maintain clarity, and ensure relevance to the aims and objectives of the Delphi process. Rules particularly relevant to this study were:

- Similar ideas were combined and if one suggestion expressed the overall concept more clearly this could be used over the other(s)
- If suggestions included more than one concept, these concepts could be removed if included elsewhere
- Suggestions may be re-phrased to express the concept clearly
- After review by the research team, suggestions may be removed if not relevant to the aims of the Delphi

At the end of this process, all suggestions and modifications were accounted for and included in the Round 2 questionnaire as appropriate.

3.8.4 Formation of Round 2 questionnaire

The same questionnaire format was used for both rounds. However at this stage participants were asked only to accept or reject statements with no further opportunity to modify.

Statements in Round 2 were unchanged, modified or inserted as new content as a result of suggestions from the panel. This information was given to the panel with each statement, alongside the overall percentage agreement or rejection from Round 1. If a statement was modified, the original was included for comparison Appendix 9).

At the end of this round, responses were entered onto a second database and the percentage agreement or rejection calculated. This final percentage was used in deciding whether statements were to be included in the pMSK curriculum (over 80% agreement) or required further discussion by the NGT panel.

3.9 Detail of Methods: Phase 2 - Nominal Group Technique

Participants were identified from knowledge of local specialists and invited to attend the meeting. Background information on the study and format of the NGT was sent with the initial invite.

As participants were recruited from across the Northern region, the only time suitable to convene was out-with normal working hours in an evening meeting with appropriate refreshments as per the ethical approval (section 3.7). One week prior to the meeting reading material was sent to all those able to attend. This consisted of the all learning outcome points with their acceptance percentage as decided from the Delphi process. Those points not currently included (below 80%) were highlighted and participants asked to consider these carefully as to whether they should be included in a curriculum for medical students. At this time it was explained to all participants that they were being asked to set a 'cut-off point' above which all statements would be included.

During the NGT meeting participants were first introduced to each other, including their clinical background. An overview of the project and progress to date was provided by the main researcher (Appendix 10) alongside the aim of the NGT; the need to achieve consensus on the cut-off point for inclusion.

The format of the NGT was as described earlier with participants asked to individually vote for their cut-off point on paper before hearing others' opinions. This was fed back verbally to the chair in turn, followed by a short facilitated discussion amongst all participants to allow clarification and justification for their decision. Participants then re-voted individually on paper before again feeding back their decisions to the chair followed by further discussion. This was repeated until a consensus opinion was reached by participants on what the cut-off point should be. The meeting was concluded at this point with the finalised pMSK curriculum content agreed.

3.10 Ethical considerations

This study proposal was peer reviewed by Arthritis Research UK (funding body) and approved by Newcastle University as a study suitable for MD research. Application for ethical approval was attained through the local Research Ethics Committee. Pertinent issues were confidentiality of participant contributions, storing and transcription of focus groups and interviews, and participant consent. No further issues were raised from this application, with full ethical approval granted. Sample participant information leaflets and consent forms are provided in the appendix (Appendix 1 – 5).

As NHS personnel were involved throughout this study, application to the relevant NHS Trust Research & Development departments was also required. This was initially approved by Newcastle Hospitals NHS Trust with subsequent applications to Birmingham Children's Hospital NHS Trust and Yorkhill NHS Trust, Glasgow as focus groups involving medical students and consultants were to be held in these hospitals.

3.11 Limitations

The aim of this study was to produce evidence and consensus-based pMSK curriculum content for medical students. Whilst the design of this study was felt to be the most appropriate way of achieving this aim there were a number of practical and theoretical considerations that must be acknowledged.

The methodology required 'expert' opinion from a number of key groups. However there was a limit to the number of participants at each stage due to practicalities, which may have led to under-representation of certain groups and domination by others. It was hoped that by involving different participants at each stage this would increase different contributions and help to minimise strong opinions. A geographical spread was achievable in the Delphi process but more limited in the other stages of this study. As the end-product is intended for all UK medical schools it was hoped that wide representation would be possible but this was within the practical constraints of a time-limited study.

There are limitations within the purposive sampling used throughout this study which must also be acknowledged. Appropriate participants are identified by the research team and invited to attend and there may be an important difference in opinion between those who agree or refuse to participate. Interested participants may have a particular interest that influences their opinion; the outcome may be quite different if a random sample was chosen that included participants who viewed the topic as unimportant. Again it was hoped to overcome this by involving different participants at each stage in order to gain a spread of opinions and suggestions.

Consensus methodology represents the shared opinion of a panel of experts. There is no scientific evidence to compare this against and it is important to recognise this when justifying the findings. There may be limitations with the definition of 'expert' hence the need for specific inclusion and exclusion criteria [139, 150]. Considering the true meaning of consensus, this may only be seen if agreement reaches 100%.

However, this is pragmatically difficult to achieve [150, 151] with many studies setting 'consensus' at a lower point than this. In this study consensus was initially set at 80% with the potential to lower this during the NGT. To achieve 100% agreement across different experts would have been unachievable in a time limited project.

The end-product of this study was to produce proposed content for a pMSK curriculum. In order to design the entire curriculum, full consideration would need to be given to assessment, environment and teaching methods [117]. This was not felt to be achievable within this methodology and timescale. The priority was to define the clinical content; this would be the focus of clinical teaching with which the study population were primarily involved in. Extended content of the curriculum requires input from and discussion with educationalists and curriculum planners who were not involved in this project; this input requires a different methodological approach and was not deemed part of this study. It is hoped that the content is rigorously produced, appropriate and generalisable.

3.12 Summary of Methods

In this chapter the methodology has been outlined with emphasis on achieving consensus from research participants on the content of a pMSK curriculum. Proposed content for the curriculum was proposed from existing evidence and data from focus groups and interviews. This content was converted into learning outcomes and distributed to representatives from all expert groups to undergo a Delphi process. After two rounds of this consensus method, items at less than 80% agreement were discussed at a Nominal Group Technique meeting to achieve final consensus.

These methods have been extensively used in healthcare and educational research and were deemed appropriate for use in this study to achieve the overall aim of defining content for a pMSK curriculum.

Chapter 4 Results Phase 1

4.1 Introduction

In this chapter the results to Phase 1 will be shown and discussed. The overall aim of this phase was to explore pMSK content for an undergraduate curriculum. This was achieved by reviewing existing pMSK educational literature and generating qualitative data from focus groups and interviews. Representatives from all stakeholder groups and medical students were involved in this stage. The outcome of Phase 1 was the production of proposed content for a pMSK curriculum which would inform Phase 2 of this study.

The aims, methods and results of the literature review, focus groups and interviews will be discussed in turn.

4.2 Critical literature review

4.2.1 Aims

The primary aim of this stage was to review relevant literature within the field of pMSK education. The specific objective was:

- To identify evidence based pMSK content for undergraduate education

4.2.2 Results

Articles deemed relevant to this stage were those containing content on pMSK education within undergraduate education.

Relevant publications were retrieved using the Medline and Scopus databases with key words ‘child’, ‘musculoskeletal’ and ‘education’, and was repeated by combining either ‘musculoskeletal’ or ‘paediatrics’ with ‘medical education’. This search was repeated on Pubmed (www.pubmed.org). Cited references within relevant publications were also reviewed, as were suggested similar articles as proposed on Pubmed.

Excluded articles included case reports and those with content not deemed relevant to pMSK undergraduate education. Many articles discussing educational intervention had a different target population to this study, for example:

- Patient education e.g. ‘Ergonomics for children: an educational program for elementary school. Heyman E. Dekel H. Work. 31(2):253-7, 2008.’

- Postgraduate education, e.g. 'Ankle fractures: emergency department management...is there room for improvement? Deasy C. Murphy D. McMahon GC. Kelly IP. *European Journal of Emergency Medicine*. 12(5):216-9, 2005 Oct.'
- Education for allied health professional, e.g. 'Clients using community occupational therapy services: sociodemographic factors and the occurrence of diseases and disabilities. Aas RW. Grotle M. *Scandinavian Journal of Occupational Therapy*. 14(3):150-9, 2007 Sep.'

Other articles focussed on clinical content with education only briefly mentioned without any specific interventions or content suggested, for example

- 'Facilitating care for childhood cancer survivors: integrating children's oncology group long-term follow-up guidelines and health links in clinical practice. Eshelman D. Landier W. Sweeney T. Hester AL. Forte K. Darling J. Hudson MM. *Journal of Pediatric Oncology Nursing*. 21(5):271-80, 2004 Sep-Oct.'
- Proteomic analysis of recurrent joint inflammation in juvenile idiopathic arthritis. Gibson DS, Blelock S, Brockbank S, Curry J, Healy A, McAllister C, Rooney ME. *J Proteome Res*. 2006 Aug;5(8):1988-95

Four articles were thought to be relevant to this stage of the study. Content identified from these publications are listed in Table 6.

Table 6 pMSK curriculum content identified from relevant literature

Citation	Suggested pMSK curriculum content	Comments
<p>Foster, H.E., et al.</p> <p>Musculoskeletal screening examination (pGALS) for school-age children based on the adult GALS screen.</p> <p>Arthritis Care and Research, 2006. 55(5): p. 709-716.</p>	pGALS screening examination	Proposed to be taught as a core skill at undergraduate level as the adult GALS screen is.
<p>Reeder, B.M., et al.</p> <p>Referral patterns to a pediatric orthopedic clinic: implications for education and practice.</p> <p>Pediatrics, 2004. 113(3 Pt 1).</p>	Normal variants of posture	Referrals deemed 'inappropriate' from primary care included those for normal variants of posture. Could be included at undergraduate education.
<p>Woolf, A.D., N.E. Walsh, and K. Akesson</p> <p>Global core recommendations for a musculoskeletal undergraduate curriculum.</p> <p>Ann Rheum Dis, 2004. 63(5): p. 517-524.</p>	<p>Common paediatric fractures</p> <p>pMSK infection</p> <p>Hip disorders</p> <p>JIA</p> <p>Common conditions requiring paediatric orthopaedic intervention (optional)</p>	Expert consultation and consensus from rheumatology, orthopaedics, rehabilitation. No paediatric input or involvement from paediatric organisations (British Society for Paediatric and Adolescent Rheumatology, BSPAR or British Society of Children's Orthopaedic Surgeons, BSCOS).
<p>Sarkin, R.T.</p> <p>Council on Medical Student Education in Pediatrics (COMSEP).</p> <p>The Journal of Pediatrics, 2001. 139(1): p. 1-2.</p> <p>http://www.comsep.org</p>	<p>Clinical skills</p> <ul style="list-style-type: none"> - Neonatal hip examination - Gait analysis - Assess normal variants of posture - Recognise joint effusions, trauma, inflammation, restricted or excessive joint mobility - Screen for scoliosis - Inspection of the back <p>Core illnesses or encounters</p> <ul style="list-style-type: none"> - limp or extremity pain - trauma - swollen joint 	<p>Proposed curriculum for undergraduate pediatrics in the United States. Not enforced or universally implemented.</p> <p>Developed by 'task force', no further information on methods applied in development.</p>

4.2.3 Discussion

This literature review has identified four publications with appropriate content for a pMSK undergraduate curriculum. However this will not fully inform a pMSK curriculum which would encompass knowledge, skills and attitudes for UK medical students [85].

pGALS was developed as an undergraduate examination skill and should therefore be proposed within the pMSK curriculum [90]. Publications from Reeder and Woolf have suggested pMSK knowledge for medical students to attain [40, 77]. The US paediatric curriculum included pMSK skills and knowledge but the exact method for development of this curriculum was not clear and this study does not take into account the requirements of a UK undergraduate curriculum [79].

No study has involved representatives from both pMSK specialists and non-specialists and no published study considered a pMSK curriculum for UK medical schools. However, appropriate content has been suggested by this literature review to be included in the proposed content for Phase 2 of this study.

4.3 Focus Groups with medical students

4.3.1 Aims

The overall aim of focus groups with medical students was to capture the insights of medical students regarding pMSK teaching at medical school. The specific objectives were:

- To consider pMSK teaching already received
- To identify content for an undergraduate pMSK curriculum
- To consider barriers to pMSK teaching

The methods used to achieve these aims were discussed in Chapter 3.

4.3.2 Results

Table 7 details the groups held, with all participants being final year medical students and were in child health rotations at the time of the focus groups. The focus group topic guide used in all groups can be seen in Figure 4.

Table 7 Composition of medical student focus groups

	Date	Participants (male: female)	Location
Newcastle S1	4/10/2007	6 1: 5 Final year students At the start of child health block, previous placement in third year	Royal Victoria Infirmary, Newcastle upon Tyne
Birmingham S2	1/11/2007	7 4: 3 Final year students Halfway through child health block (no previous placement)	Birmingham Children's Hospital
Glasgow S3	4/2/2008	5 2:3 Halfway through child health block (no previous placement)	The Medical School, Wolfson Building, University of Glasgow

Figure 4 Topic guide used for all focus groups and interviews in phase 1

Aims

- To explore current practice and barriers to teaching pMSK clinical skills
- To gain views on possible content of a pMSK teaching package
- To discuss ways to teach pMSK clinical skills, and materials needed to help facilitate these

Objectives

- By the end of the focus group the researchers will have:
- Identified the ways in which students are being taught pMSK at present.
- Distinguished between teaching methods that have worked well, and why this could be, and methods that have work less well, and explore why this could be the case.
- Garnered opinion as to what a teaching package in pMSK clinical skills should comprise of from student, teacher and expert perspectives

Questions

- Tell me about teaching pMSK. How would you describe your teaching experiences?
- What works well when teaching pMSK? And what doesn't?
- What factors prevent you teaching? How do you think these could be overcome?
- What do you think students should know about pMSK?
- How do you think this could and should be taught?
- Are there materials you would like to help you teach pMSK? What formats?

General outline for focus group

0-10 Introduction, background and objectives

10 – 25 Current practice: what works well? What doesn't?

25 - 40 proposed content: what should be included?

40 – 55 proposed method : how should the above be taught? What would help you?

55 – 60 Summary, conclusions and thanks

Introduction

Good afternoon and thank you for participating. The aim of this focus group is to produce relaxed discussion around paediatric musculoskeletal teaching to medical students, and your opinion and participation is very much appreciated and valued.

Purpose

We are here to get your experiences of teaching pMSK to medical students (to students – of being taught). I would like to explore your good, and not so good, experiences, and find out works well and what doesn't. I would also like to hear your view on what you think a medical student should know about pMSK, and in what ways that could be taught. The outcomes of this discussion will help in the development of a teaching package for pMSK. There is no right or wrong, and I hope you will feel comfortable to say what you think.

Procedure

This discussion will be recorded and then transcribed; all contributions are treated as anonymous. The focus group will last 1 hour; I may have to move things on as we have several areas to cover.

Dialogue

To start, would everyone mind introducing themselves, and say where they work (study) at present, if they have a teaching role with medical students, and any recollections they might have of being taught pMSK as students themselves?

Closure

We seem to have reached the end of our time today. We have heard many different opinions today and had very productive discussion, and I thank you for that. Some conclusions we can draw are that your experiences of teaching pMSK are in general _____, and that we should be including _____.

Is there anything else that anyone would like to ask or add before we finish? Thank you for your time and participation. Your contributions are invaluable in the construction of this teaching package¹.

1. Current practice

To consultants Can you tell me about your current experiences of teaching pMSK to students?

To students Have you been taught about pMSK so far?

Probes	Prompts
If not, why? If so – do you enjoy it? What works well? What are the good things about teaching pMSK? What are the barriers to teaching pMSK? To students If so, can you tell me about it? What kind of teaching experience was it (ie positive or negative)? Do you know why you described it that way? If not can you tell me about your MSK teaching in adults? What kind of experience did you find that? What worked well and what didn't?	Time Knowledge Curriculum Learning outcomes

2. Proposed content

What do you think students need to know before graduation about pMSK medicine?

Probes	Prompts
What is a realistic in the undergraduate curriculum? What are the boundaries? Essential vs desirable? From your clinical experience what do students need to be aware of? What do you expect FY1 doctors to know and do? Relationship to RCPCH core competencies?	Learning outcomes Core presentations Red flags Clinical skills MSK knowledge

3. Teaching aids

What would help you to teach pMSK, particularly those aspects we have just been talking about?

To students: what would help you learn about pMSK?

Probes	Prompts
Are there things that would enable you to teach pMSK better/overcome barriers? Have you examples from teaching other systems of things that help?	What formats would you like these to be in?

General teaching experiences

Students discussed their general experiences within undergraduate clinical teaching, with particular reference to child health. They described positive experiences when teachers that appeared enthusiastic about teaching and were keen for students to learn. Similarly, comments given about “good” teachers described them as those that appeared friendly, suggested improvements in an encouraging way, and taught on content relevant for students such as covering learning outcomes or exam content. Examples of useful clinical teaching experiences included those where they had the opportunity to relate a condition to a patient

“The things that I remember are when I have seen patients with something”

Medical Student L, Site 1

Negative experiences led to discussion. Examples given included times when students felt humiliated or belittled by teachers who may have been too busy with clinical duties and put students as low priority.

“It is just so off putting going somewhere and somebody going ‘oh I have got an hour’ or ‘I am really busy we will just go and see a few patients’ and just being really not enthusiastic”

Medical student E, Site 2

Students shared good experiences of being taught by each other but felt this did not replace consultant teaching. Learning how to approach and develop a rapport with children was brought up in all groups as a challenge for the students with accompanying comments that they hoped to learn from observing doctors in practice.

“It is very useful to watch how other people do it...if a child starts to get distressed how a doctor would then deal with that by either stopping what he was doing or making it more fun or getting the parents involved...you can pick out bits that you think work...try it yourself”

Medical student H, Site 2

Specific paediatric clinical skills were also discussed. Observations were raised by students that history taking was felt to be less focused, and examination difficult due to lack of co-operation and fear of hurting the child.

“I think a lot of the time I don’t really trust what I find on examination and it is even harder in children if they are wriggling about or you can’t give them a specific instruction...I find it harder and the parents are watching and you think oh I am not hurting your child, honest”

Medical student W, Site 3

Practical aspects to child health were raised. Students commented that there may be a limited number of paediatric in-patients to see with any interaction dependent on parental consent and presence. In one group, descriptions were given on the differences within adult medicine, where they would see the same patients regularly and feel part of a team.

“We come from medicine which was a very like intense firm. You stood like you were with your firm for 6 weeks and that is where you were and you were on that ward and so it is kind of weird to go from that... knowing people quite well in the firm and then going to like I don’t even know who the doctors are, what their names are, who to ask for”

Medical Student H, Site 2

Current pMSK teaching

Students were asked to describe any pMSK teaching they had received to date and to expand on any positive or negative aspects to this experience.

pMSK teaching experience varied. One group recalled it being mentioned during adult MSK teaching. Both other groups reported specific pMSK teaching: small group teaching, lecture, rheumatology clinics and paediatric orthopaedic seminars. Students described the MSK assessment as being different in paediatric patients compared to adults although they were not sure exactly what those differences were. One group highlighted a ‘surgical sieve’ approach to pMSK diagnosis as being useful for their learning. Students described theoretical sessions such as lectures or case studies as useful but wanted this to be reinforced with clinical experience, with particular emphasis on learning how to adapt an examination to a child.

“With kids they are a lot more bendy and a lot more flexible and you are like...is this normal, or can they go any further and you don’t want to hurt them but you have got to kind of get a good sort of assessment of their condition”

Medical student H, Site 2

“You can teach how to do the examinations and that is fine but you have just got to hang around kids and practice”

Medical student G, Site 2

Specific difficulties in learning about pMSK medicine were described by the students. In the group with very little teaching they felt there was little importance put on pMSK medicine. The students had observed little pMSK assessment by practising consultants and this felt this had an impact on how they learned about it.

“I have never even seen a child being examined by another doctor when I was there...so I didn’t know anything about it”

Medical student K, Site 1

Examining children and a fear of causing pain was described by students, who felt it was more difficult to examine a child compared to an adult. Particular pMSK challenges related to the need for children to co-operate with instructions, as opposed to cardiovascular, respiratory or abdominal examination where the child simply needed to lie still. In all groups there was discussion on pMSK examination being reinforced less in bedside teaching compared to other systems.

“You have to be aware that you might cause them some discomfort and kids react differently to adults...when you are an adult you can kind of reason...I am sorry if it caused you a bit of pain...whereas with kids they can like say forget it and you are not touching me anymore”

Medical student E, Site 2

“Someone who has got something wrong with their heart, a heart murmur, you are not going to be affecting them by listening with a stethoscope, whereas if someone has got really bad arthritis and they can’t walk, to either get them to walk and then try and move the knee around is really going to disrupt them”

Medical student L, Site 1

“Just seeing someone do it is so useful because a lot of the rheumatology examination is knowing how to orientate the child. You know when you say how to make the child understand what you mean when you know raise your leg and things like that and it shows you really good ways of doing it on the DVD. It actually shows someone doing it so you can learn from that”

Medical Student G, Site 3

Proposed pMSK teaching

All proposed pMSK curriculum content is listed in Table 9. Students raised the need for skills to allow them to function in their Foundation Year posts and be able to assess children with MSK presentations. Examples of these were clinical skills such as history taking and examination, recognition of red flags for serious conditions, investigations and referral pathways.

“Because if you are the FY1 on-call...people are going to be happier with you if you have ... if you have kind of done the basics so if you have done either any appropriate blood tests or any x-rays ... so I think it is probably useful to know what investigations are appropriate for what condition”

Medical Student J, Site 3

Areas of pMSK knowledge that students thought were important were identified. These included conditions such as infection, malignancy, trauma and arthritis, along with the ‘child with a limp’ and ‘normal variants’. There was some discussion on the differences between adult and children MSK medicine (such as key points in the history or examination).

“Because kids, it is lot harder to examine a kid, any exam, than a ... especially young ones because you don’t want to just sit them down and go through how you would an adult”

Medical student L, Site 1

In the students’ discussions they described the ideal ways in which pMSK teaching could be delivered which included small group clinical teaching on patients with pMSK diseases and seeing patients in clinic before their appointment. Additional

resources such as DVDs, pictures, handouts and elearning resources were desirable but it was clear from their comments that these did not replace clinical teaching.

“I think the best way to remember things is to actually see them. Reading it in a book is not as good as saying a patient with a swollen knee or something because then you remember it and you think oh that guy had that yeah I remember what that was like. So even if it is just if you can’t get patients I don’t know pictures or DVDs or something that like.”

Medical student W, Site 3

“Just seeing someone do it is so useful because a lot of the rheumatology examination is knowing how to orientate the child. You know when you say how to make the child understand what you mean when you know raise your leg and things like that and it shows you really good ways of doing it on the DVD. It actually shows someone doing it so you can learn from that”

Medical student G, Site 2

“I think you have to see it. I think you need someone to stand there and say no you are doing that wrong. You need to get your hands like this or you need to push further or that’s a swollen ankle not that. That is not a swollen ankle”

Medical student H, Site 2

Students expressed a desire for learning outcomes to be structured and alert them to the depth of knowledge required. When talking about their child health learning outcomes one commented:

“This makes us think we need to know everything about everything that is on our list but in our medicine learning outcomes they were set out slightly differently, in the way that they said you need to be able to recognise these things, you need to know about these things in some detail, you need to know these things really well”

Medical Student K, Site 2

4.3.3 Discussion and summary of findings

The following points could be drawn from these focus groups with medical students.

Enthusiastic teachers, with knowledge of students' learning needs, delivered the best clinical teaching. Students enjoyed teaching if they were involved in the clinical environment and encouraged to feel part of the clinical team. This is in keeping with previously published focus groups with students where consultants were identified as important role models[107].

There were significant differences between adult and paediatric patients that worried students and they requested efforts in teaching to explore these differences.

Examples of this would include showing students how to establish rapport with children and involvement of both the patient and carer; this may be achieved by observing clinicians at work. These barriers to learning about child health and pMSK medicine are listed in Table 11.

Students suggested ideal pMSK content for undergraduate medicine, based on their experiences alongside factors they felt to be important to allow them to practise as a foundation doctor and are listed in Table 10. Clinical skills such as history taking and examination were important as well key conditions and 'red flags' for important or life-threatening pMSK diseases. A structured approach to formulating a differential diagnosis was helpful. They requested some knowledge of investigations and management, which would be important for work after graduation and also wished to know about key conditions. It was felt that learning outcomes needed to be appropriate for students with an idea of the depth of knowledge required. Additional learning resources were welcomed but in addition to, as opposed to replacing, clinical teaching.

It was important that the pMSK curriculum incorporated these suggestions from students and consideration to all these factors was made when designing statements for the Delphi process. Designing the learning outcomes with student needs in mind was of particular importance and a section on establishing rapport with the parent and child was added on the basis of this emergent theme.

4.3.4 Critique

Medical students, as a key stakeholder population, were an important part of this project. By undertaking focus groups in three locations efforts were made to cover

both breadth and depth of student opinion and ensure their views were adequately represented.

However there are criticisms of the location choices. All three cities are large industrial cities, albeit in geographically distinct parts of the country, a university located in a smaller city such as Aberdeen may have produced more contrast. Several 'new' medical schools are in existence (such as Warwick, Keele and Hull-York medical schools) are in existence with recently developed curricula. Student experiences at these universities may have been interesting to compare to those at established medical schools.

All three universities chosen have links with tertiary paediatric rheumatology departments, which may influence the pMSK component of their teaching. The variable pMSK teaching between these groups may reflect this. Students in Newcastle were at the start of their final child health block, with their previous experience located in a geographically distinct part of the region (and without a paediatric rheumatology presence). They therefore had minimal pMSK experience to date and found it lacking in their knowledge. In Glasgow and Birmingham students were placed in large children's hospitals with academic paediatric rheumatology departments and had already received teaching from this specialty.

This may be both a strength and weakness. Students with pMSK knowledge may be better placed to describe what is important to learn, and how this should be delivered. However over-exposure to pMSK teaching may lead them to believe they require more knowledge than others would think necessary. It was important to remember throughout this project that pMSK medicine is one sub-specialty within child health and the amount of knowledge required must reflect this.

A pragmatic consideration was the organisation of these groups and as paediatric rheumatologists were the key contacts for this project they allowed access to students and R&D approval. These practical aspects are important in a time-limited project and the timely arrangement of these groups close together at the start of the project was a definite advantage.

Overall, taking the strengths and weaknesses into account, there was productive and useful output from these focus groups which were a key component of the project overall.

4.4 Focus groups and interviews with consultants

4.4.1 Background

This part of the project sought participation from the remainder stakeholder groups. As explained in Chapter 3, the views of both ‘experts’ and ‘non-experts’ within pMSK medicine were deemed necessary to explore, and allow insight into the important aspects for both the generalist and specialist. Further to section 4.2.1 and discussion around ‘teacher’ versus ‘student’ views, groups with specific teaching remits were also felt necessary to be included. However, as most clinicians are involved with undergraduate education, it was hoped that all groups would be able to offer insight into the teacher perspective.

4.4.2 Aims

The overall aim of focus groups with clinicians was to discuss pMSK clinical skills in general, with specific focus on current and ideal pMSK content to be taught to medical students. The specific objectives were:

- To consider perceptions of pMSK clinical skills in practising clinicians
- To discuss and identify current pMSK teaching experiences
- To identify ideal pMSK curriculum content for undergraduate medical students

The methods used to achieve these aims were discussed in Chapter 3.

4.4.3 Results

A total of four focus groups and three interviews were held with clinicians and an overview is provided in Table 8.

The initial methodology had proposed a focus group with orthopaedic surgeons, as pMSK experts. This was originally planned to be held alongside the BSCOS national meeting in January, in keeping with the timing required for this study. However, this meeting was cancelled at short notice with the offer of re-scheduling the group to June 2008. Although this was after the planned start date of the Delphi study, it was decided to proceed with this focus group in order to maintain the strong relationship with the paediatric orthopaedic community, and ensure their input was present throughout the study. Interviews were held with paediatric orthopaedic surgeons while the other focus groups were being conducted, and their contributions were included as Delphi content.

Table 8 Format of focus groups and interviews with consultants

Date	Format	Location	Participants
2/11/2007	Focus group 1 (FG1)	Birmingham Children's Hospital	Professor in diabetes (n=1) Consultant paediatricians (n=4) <ul style="list-style-type: none"> - pMSK interest - oncology interest - education interest - diabetes interest 4 male : 1 female
21/1/2008	Focus group 2 (FG2)	Birmingham Children's Hospital	BSPAR Executive Committee Consultant paediatric rheumatologists (n=2) Consultant paediatrician with pMSK interest (n=1) Adult rheumatologist with pMSK interest (n=1) Paediatric rheumatology physiotherapist (N=1) 3 male : 2 female
5/2/2008	Focus group 3 (FG3)	Royal Victoria Infirmary, Newcastle upon Tyne	Consultant community paediatrician (n=2) Professor in primary care (n=1) Consultant in emergency medicine (n=1) Consultant paediatric neurologist (n=1) 3 male : 2 female
14/2/2008	Interview 1 (IC1)	University College Hospital, London	Paediatric oncologist (female)
9/5/08	Interview 2 (IC2)	Telephone	Paediatric orthopaedic surgeon (male)
12/5/2008	Interview 3 (IC3)	Royal Hospital for Sick Children, Glasgow	Paediatric orthopaedic surgeon (male)
26/6/2008	Focus group 3 (FG3)	Bristol	BSCOS Executive Committee (n=8) 7 male : 1 female

General pMSK skills

Consultants discussed pMSK teaching in their own undergraduate training. Few recalled any specific pMSK teaching although several were taught MSK clinical skills on adult patients, generally by orthopaedic surgeons.

“It was very much regional musculoskeletal examination so I learned how to examine the knee very well and the hip well but not the whole person and obviously on adults rather than children. I don’t think I had any musculoskeletal training in paediatrics”

Consultant paediatric rheumatologist

One consultant commented on the lack of musculoskeletal basic sciences teaching in his experience.

“In my first MB teaching about the anatomy and the physiology for that matter of the musculoskeletal system if pretty poor so I think personally from my own development I started with a pretty poor knowledge base even for basic clinical science”

Professor of Paediatrics

In all groups, consultants made observations that paediatricians were poor at examining the MSK system in children; this point was brought up by both generalists and specialists. Paediatric rheumatologists were concerned about the lack of pMSK clinical skills in their primary and secondary care colleagues. Discussion about this raised an issue about the general management of children with MSK problems and the influence this had on the late diagnosis of many children with arthritis.

“A lot of children with musculoskeletal problems actually do just languish out there until either it just gets better...or they end up with pain syndrome because it has not been addressed properly, or they have got inflammatory disease that then becomes obvious...it sort of gets managed by default, almost without anybody being confident about managing it”

Paediatric rheumatologist

Consultants discussed the importance of all doctors being able to assess the MSK system in children. In particular, the ability to perform and modify the history and examination depending on the child’s presentation was highlighted by all groups and

discussed at length in the group with differing specialties. This discussion led to the group comparing the same presentation (a child with a limp) to each of their own specialty and how the diagnosis and management might differ.

“It is interesting to hear the neurological slant to the MSK examination, the neuro-developmental slant to the MSK, and then you have got the trauma slant...and the brilliant thing is maybe they need a combination of all but focussed to what they are actually looking for”

Paediatric emergency consultant

“I just want them to assess somebody in a relevant logical manner which is relevant to that presenting complaint”

Paediatric orthopaedic surgeon

Experiences of pMSK teaching

Many consultants were participating in pMSK teaching already. Experiences were shared on this teaching requirement leading to participants improving their own pMSK clinical skills, either through textbooks or by asking pMSK expert colleagues.

“I had to go and look it up and make sure that I understood that I wasn’t missing bits of it because I don’t think I had ever been taught it as an examination”

Paediatric oncologist

Those involved in teaching described their teaching content. This included examination skills, usually a screening examination such as pGALS, but a variety of other teaching sessions were offered:

- Differential diagnosis of MSK presentations according to age
- Overview of JIA including multidisciplinary team
- Observation of gait
- Developmental and gross motor abnormalities
- Opportunistic teaching within primary care
- Overview of the limping child
- Common pMSK clinical signs e.g. swollen joints, nail pitting in relation to JIA and other conditions
- Paediatric fracture management

- Orthopaedic problems in the under 5-year-olds
- Late diagnosis and why it matters (in pMSK conditions)

During discussion, observations were raised by consultants that students might be keen to learn about pMSK medicine but their teachers were reluctant to teach on it, focussing on other clinical systems instead. Indeed it was felt that these systems took priority over most others with neurology, Ear, Nose and Throat and ophthalmology suffering as well:

“It (referring to pMSK teaching) is probably done badly. It is probably overlooked quite a lot and the medical students are very keen to understand it better and know it better”

Professor in Diabetes

“Everyone thinks about hearts and lungs and abdomens...We (paediatricians) are poor at examining skin and eyes and all the other non-headline acts and MSK system just gets chunked in”

Paediatrician discussion, FG1

One group highlighted the impact exams have on students' motivation to learn. Within this discussion, the introduction of pMSK medicine into the postgraduate examination for the Royal College of Paediatrics and Child Health was raised with the observation that this had led to an increase in requests for postgraduate teaching which could be avoided if pMSK education was delivered earlier. Comment was also made about the lack of in-patients with pMSK problems and the impact this has on exam content.

“Registrars all feel very uncomfortable examining the MSK system... (the introduction of MSK into exam) very much focuses them on ‘I need to know this’. I suspect that if education was put in at a much earlier date then it wouldn't be the same pressure on the people preparing for an exam to suddenly cram in a brand new skill”

Paediatrician with pMSK interest

“I have taught medical students the basics of musculoskeletal examination. They are all very keen to learn it actually....because we put it in the exam”

Professor of Paediatrics

“They are really focussed about what they are going to be examined on...because they (patients with pMSK problems) are outpatients and most of their end of block exams are on patients who happen to be on the ward, it is not a priority for them”

Paediatric Rheumatologist

pMSK experts raised some issues related to their own teaching experiences. One orthopaedic surgeon observed that despite orthopaedic patients being in hospital, they were often plaster, traction or recovering from surgery so not easily accessible . Paediatric rheumatologists discussed that other admissions may have MSK pathology in relation to their presenting problem, and indeed MSK could be examined in any child. Other opportunities such as outpatient clinics could be used for teaching purposes but it was felt that in busy clinics there was rarely enough time to allow dedicated teaching time, and they were not always conducive to good teaching.

“In clinics, unless you get them (students) to actually examine the patients before you, which s quite tricky sometimes, time-wise, they are just sitting zombies really”

Paediatric Rheumatologist

The group involving paediatric rheumatologists (FG2) discussed the small presence they had amongst paediatric departments across the UK, and the limited influence they could have on including pMSK within general child health teaching. They felt that all those involved in child health teaching (i.e. all paediatricians) should be able to teach pMSK clinical skills, and it should not be left to the ‘experts’.

“Our colleagues, a lot of the general paediatricians don’t know how to assess musculoskeletal problems too you know. We are paediatric rheumatologists, have an idea on how to take a history and assess patients but how many of us are there around the country? And actually we are not the one that are teaching most of the medical students. It is actually the general paediatrics and if (they) don’t feel confident and comfortable with doing these things then they are going to veer away from teaching”

Paediatric Rheumatologist

Consultants shared their thoughts on specific challenges that students faced. These included the need for students to feel comfortable in approaching and examining children, and gain knowledge of 'normal' throughout childhood.

"Before you can examine a child you have to know they are different, they are going to react to you differently, just the way we use toys, we use play, we use distraction to get them involved before we can even look at them and examine them. But I think medical students when they first come in they don't have that"

Consultant Paediatrician

They (students) have to learn that there are going to be approaches that are going to be very different from an adult who can follow instructions...when you look at their faces when they are going to see someone (a child) there is horror written on the medical student's face.

Consultant Paediatrician

It was discussed that maybe students were scared of causing pain to patients and it had been observed by some participants that students reviewing acute admissions were reluctant to perform examinations on a distressed child prior to the assessing doctor, thereby missing an opportunity to pick up clinical signs.

"You avoid something that you are not comfortable with because you are not quite sure what you are going to find...how do you get medical students to understand that actually it is not helpful to avoid and you do need perhaps to do things that are uncomfortable...part of it is about engaging all the children and working with children and communicating with the child"

Paediatric Oncologist

An understanding of context and why examination or tests are needed may be difficult for students to grasp.

"I think when you're a medical student you probably don't understand in a way that you do when you're a jobbing clinician...it is like learning to drive a car – you pass the test and then you really learn how to drive. For me that is how medicine felt, you do all the tests but actually it is only once you are doing it, the job, it really makes sense as to why you are doing it"

Paediatric oncologist

Proposed pMSK content

There was agreement amongst all participants that pMSK clinical skills and knowledge should be taught to medical students. These are included in Table 9.

Items raised within all groups and interviews included understanding the different approach to children compared adults, with particular reference to the MSK examination. It was felt that students should be able to recognise red flag conditions such as malignancy and infection and know about the limping child. In general it was hoped that students could understand broad concepts within pMSK medicine with the understanding that these were general skills to be built upon as postgraduate trainees.

“They need to be able to perform a competent MSK examination, be able to recognise that there might be a MSK problem going on here and they need to be able to describe their findings and be observant to actually someone senior when they are reporting because they are junior doctors. If they can just have those 3 skills I would be happy with them as they graduate from medical school”

Professor of Paediatrics

Specific teaching concepts raised in the group with mixed specialities (FG3) included students needing to understand how to act around children and the process of engagement and distraction. They discussed students understanding ‘normal’ development with reference to the MSK system. Participants in this group proposed content relevant to their own practice (e.g. emergency medicine and trauma, community paediatrics and developmental awareness) with general agreement amongst the group that these were appropriate suggestions. However discussion led to clarification on the extent of knowledge required on gait, with group contributions enabling agreement that students should be able to describe gait broadly, and decide on the area causing the problem.

“A description (of what they have seen) and then try to pin it down...where is that gait problem. Is it in the muscle, is it in the bone, is it in a particular joint ...functional anatomy”

Consultant in Emergency Medicine

Specialty specific pMSK content

pMSK experts discussed the important aspects within their subject that students should know. Within Table 9 all suggestions are listed, with the majority being mentioned in more than one focus groups or interview. Paediatric rheumatologists highlighted pMSK clinical skills that would allow students to recognise inflammatory joint disease and other important pMSK conditions which included a basic level of skill and knowledge.

“They need to know a bit about arthritis and the importance of eyes and why it is important to make a diagnosis, and what things might be considered like malignancies...I think beyond that they don’t need to know a great deal of detail. Because we are not training them to be rheumatologists, we are not even training them necessarily to be paediatricians, we are training them to...actually remember that children get these various things”

Paediatric rheumatologist

Other points raised in this group only included the concept of students understanding chronic disease in childhood and the role of the multi-disciplinary team in children with JIA. They proposed that this teaching subject was not limited to pMSK medicine but could be applied generically across chronic diseases within child health teaching.

“Across borders of any chronic disease about managing the diagnosis and chronic treatment monitoring, treatment impact on growing and developing and access to all of the things you need for adolescence , you know all of those generic things are not just for rheumatology they are actually across the whole base”

Paediatric Rheumatologist

The physiotherapist in this group highlighted the importance of adolescence and the impact this has on MSK development and disease. Other adolescent issues raised included communication and impact of chronic diseases. It was raised that students might worry about adolescent encounters, as they were often very close in age to the patients.

The paediatric oncologist discussed engaging the child and ensuring their comfort. She retained an overall attitude that students should know basic principles that could then be developed in later training.

“As with everything in medicine, taking a good history and making sure you have excluded the things that are life threatening or limb threatening or you know are likely to cause immediate problems”

Consultant paediatric oncologist

She discussed the knowledge needs of students with regards to childhood malignancies. Although these were rare in general, they were potentially life threatening and patients report seeing many health professionals before eventual diagnosis. She felt that education about presentation and detection was important and some understanding of acute leukaemia was essential, as the commonest malignancy in childhood often presenting with MSK symptoms. Specific content for pMSK malignancies included taking a thorough pain history, enquiring about back pain, and accurate assessment of swellings.

Orthopaedic surgeons discussed their desired knowledge for students. They raised areas such as understanding the normal variants of posture, recognition of infection, inflammation, developmental dysplasia of the hip (DDH), fracture and tumours. Specific examination points they identified were assessment of bony tenderness and examination of the hip joint. Other core conditions and examination principles were shared with contributions from other participants.

Suggested pMSK teaching resources

Teaching resources were felt to be useful in reinforcing pMSK clinical teaching, particularly if students did not see patients with physical signs.

Location and environmental suggestions included outpatient clinics with protected teaching time, and seeing patients on the ward without pMSK problems in order to practice examination. The paediatric rheumatologists suggested joint injection lists as a suitable teaching opportunity and paediatric orthopaedic clinics were reported as another opportunity rarely taken up by students.

Additional resources that could be developed were welcomed but felt to be complementary to clinical teaching as opposed to replacing it.

“The ultimate resources are patients but they are not always available at the time you want to so it”

Paediatric oncologist

Resources suggested included photos, x-rays and DVD clips. DVD in particular was felt to be useful for showing developmental changes in gait, clinical signs such as swollen joints and limitation of movement, and general gait descriptions and assessment. Teachers discussed using these to illustrate important points to students, particularly when there was a paucity of patients with pMSK signs. Interactive resources were felt to be useful such as progressive case histories (showing treatment and improvement) or electronic seminars similar to those developed by other organisations (e.g. Royal College of General Practitioners e-learning modules). Assessment tools would be welcomed, particularly in the group acknowledging that students were more likely to learn if they will be tested (FG2). Summary handouts containing important information on key conditions and red flags were felt to be useful both for guiding teachers and student education.

4.4.4 Focus group with orthopaedic surgeons

This group was held while the Delphi process was ongoing, for reasons explained earlier in this chapter. They discussed the importance of students knowing about normal variants of posture, common MSK terminology and the ability to describe MSK landmarks. The limping child and understanding of simple fracture management were also raised as important topics for students.

This group were very aware of the limitations of pMSK teaching and realistic that students could not be expected to learn extensive pMSK content. They had variable input into current pMSK undergraduate teaching but were keen for students to understand basic principles be taught pMSK clinical skills before graduation.

“(during medical school, students) don’t get exposed to patients, they don’t get exposed to clinical scenarios and they don’t get exposed to real trauma and orthopaedics or rheumatology. It is all virtual...So unsurprisingly when they become GPs they have got no idea what to do when they are confronted with 30% of their consultations”

Orthopaedic Surgeon

“I think if you ask how it should be done. I think the emphasis should be on what they are going to see in the clinic as a GP and be able to say that matters and that doesn’t and the only way ... an hour’s lecture isn’t going to do it”

Orthopaedic Surgeon

4.4.5 Discussion and summary of findings

Focus groups and interviews with clinicians have produced important points regarding pMSK clinical skills in general, current pMSK teaching and suggestions for future pMSK teaching as can be seen in Table 10.

pMSK clinical skills were felt to be poor amongst paediatricians in general. This reinforces evidence in the literature of poor performance [30] and low self-confidence in paediatricians' pMSK clinical skills[28]. Participants described receiving very little pMSK teaching themselves in keeping with recent studies [72] which may be contributory to the lack of skills seen in practice. This worried pMSK experts who felt that poor clinical skills in referring doctors led to the known delay in presentation for children with arthritis [43, 46-48].

Many participants were involved with pMSK teaching currently. This was not limited to pMSK 'experts' and was often driven by requests from students or curriculum requirements, an encouraging finding. Some described having to improve their own pMSK skills prior to teaching. The development, therefore, of resources aimed specifically at teachers may be welcomed.

Clinicians raised specific barriers to pMSK teaching and are listed in Table 12. The perception that pMSK clinical skills were regarded as lower priority than other systems teaching is consistent with findings in the literature [72]. This may be attributable to the low confidence teachers have in their own pMSK clinical skills. However it was felt that all teachers of child health should be able to teach pMSK medicine, with pMSK experts feeling that they did not have the workforce or widespread presence to deliver this teaching themselves. Improving confidence in doctors' own pMSK clinical skills may help to improve their confidence in pMSK teaching.

Other barriers were discussed. The limited presence of pMSK in undergraduate curricula and non-inclusion into student assessment were thought likely to contribute to the lack of teaching, consistent with the 'assessment drives learning' concept felt by many teachers [171]. Lack of in-patients with pMSK presentations means it featured infrequently in bedside teaching, which was usually the focus of child health teaching. Including students in outpatient clinics could overcome this barrier but this needed to be an educationally meaningful experience for both teacher and student as busy clinics may not be conducive for student to learn. This struggle between clinical and teaching commitments has been highlighted in other qualitative

studies on teaching and is in keeping with other focus groups with consultant teachers[107]. Special ‘teaching clinics’ may need to happen to achieve a balance between clinic management and student teaching.

It was recognised that for many students learning how to act around children was a barrier to learning child health in general. Establishing rapport and the ability to engage children needed to be recognised in any child health curricula, including developmental considerations such as adolescence. This is perhaps even more important in pMSK medicine where there is potential to cause pain or discomfort, and the requirement for co-operation is greater than other bodily systems such as cardiovascular or respiratory. An interesting proposal by one participant suggested empowering students to understand about pain management means they are more likely to approach a child in pain and consider how best to manage the situation. This was clearly an important item of curriculum content to put to the Delphi panel for consideration, which is not at first obviously related to the pMSK system but has clear relevance. These generic barriers to child health teaching were also raised by students and must be acknowledged in the pMSK curriculum.

pMSK teaching content suggested by consultants included general child health skills, specific pMSK clinical skills, red flags and knowledge of key pMSK conditions. All suggestions are listed in Table 9 and it can be seen that many were proposed by more than one participant. There was general acknowledgement and agreement across specialties on the basic level of knowledge and skills that students require that can then be built upon in postgraduate training. Some suggestions were specific to the consultant’s background. Examples of this included non-accidental injury suggested by community paediatricians, and management of fractures suggested by the emergency consultant. This showed the importance of ensuring contributions from a variety of specialties with pMSK interest.

It might have been expected that pMSK experts expected a higher level of knowledge about their conditions, but it was clear that this was not the case. Indeed their discussions seemed to focus on equipping students with pMSK clinical skills and enough knowledge to consider diagnosis and appropriate referral. Orthopaedic specialists raised conditions that they saw commonly in their practice, with their focus being the appropriate level of knowledge for primary care doctors, based on their common source of referrals and the fact that this pathway will be taken by many graduating doctors. The advent of the Foundation programme means that students are working in primary care directly from graduation. Students, in their focus groups,

were also keen to feel equipped with the appropriate level of knowledge to function as a newly graduated doctor.

Teaching resources were suggested to accompany undergraduate pMSK teaching. These could include location suggestions for pMSK teaching such as clinics and joint injection lists. Other resources could support clinical teaching, such as materials to illustrate clinical signs and features of disease. It may be useful to consider the barriers raised within this study when developing resources for the final curriculum.

4.4.6 Critique

There were clear advantages in using focus groups and interviews to explore pMSK teaching and proposed content. Discussion in focus groups allowed group ‘synergy’ to take place, with opportunity for participants to agree, disagree or seek clarification with each other[132, 135]. This did indeed happen on many occasions, with group agreement often leading to more discussion and suggestions, and encouraging contribution. Clarification was an important process within the groups, particularly shown with the example of gait and students’ needs within FG3. Groups with experts were important in defining the key points for their specialty and helped to emphasise the pivotal role they played in this project. This contrasts with the mixed groups, where discussion about each other’s needs and experiences was often enlightening to participants and led to further discussion. An example of this occurred in FG3 when they explored how different the MSK assessment was to each of their specialties.

Interviews allowed participants to suggest content specific to their own experience, and in all interviews there was a clear appreciation that this was targeted at the undergraduate population. The discussion and exploration within interviews was in more depth than in focus groups; a definite benefit in the interviews with orthopaedic surgeons as their focus group had not taken place.

There are criticisms of these groups and interviews to acknowledge. Many of the participants were already involved in pMSK teaching, which may not be representative of the general child health teaching population. This is a criticism of purposive sampling, and it is also recognised that volunteers for processes such as focus groups and interviews may have a vested interest in the subject. Established teachers were more able to discuss the barriers to teaching however, and had experience behind many of their suggestions for curriculum content which was productive for this project.

Within focus groups the group synergy can mean that the group simply agree with each other with participants reluctant to disagree. There were indeed few examples of disagreement in these groups which may reflect reluctance to 'rock the boat', or simply meant that participants only gave appropriate contributions. As professional specialties offered different views of proposed content it may have been useful to conduct further groups with relevant specialties such as primary care or emergency medicine. However this phase needed to be kept within a realistic timescale, and there was further opportunity provided for participant contribution within Round 1 of the Delphi process. As with all focus groups the role of the facilitator is key to enable good discussion and achieving the aims of the focus group. As the facilitator was also the key researcher on this project, which was known by the participants, this may have introduced bias to the group.

In interviews, the participants were able to explain in detail their thoughts and views on pMSK teaching, which may lead to bias based on their clinical knowledge and specialty. However these were analysed alongside group data, and generated some specialty specific content that may not have been discussed otherwise. However, very few new concepts were introduced through interviews alone.

A clear criticism is the timing of the focus groups with BSCOS. Although this was unexpected, interviews were held to ensure orthopaedic input and their contribution very much valued. Reassuringly, no new data was produced from this focus group although it was still a useful part of the research, and indeed a reassuring 'check' on the content proposed in this phase and that within the Delphi itself. It was important for credibility and future research work to ensure the orthopaedic contribution was present and valued.

4.5 Conclusion

Focus groups and interviews with clinicians and students allowed discussion and exploration of three key areas. They have described examples of current pMSK teaching and explored the barriers and difficulties in delivering and receiving this. pMSK medicine content has been proposed for an undergraduate curriculum, taking into account students' needs, and with contributions from different key specialties. Resources suggested would support this teaching and help to overcome the barriers faced by both students and teachers. This content needs further review; the aim of the Delphi process in the next phase of this project to achieve consensus.

Table 9 pMSK curriculum content proposed from focus groups and interviews listing all suggestions given by participants

Source coding

- S1, S2, S3 Focus groups with medical students 1, 2, 3
- C1, C2, C3 Focus groups with consultants 1, 2, 3
- IC1, IC2, IC3 Individual interviews 1, 2, 3

Letter following initial code indicates the originating location on the data framework for that item, for example: C1j relates to Focus groups with consultants (1) with item location in framework box j

Core conditions	Source
Septic arthritis, osteomyelitis	S2l, C1i, IC2h, S3k, IC3i
Malignancy	C1i, C2j, S2l, IC3i
Legg-Calvé-Perthe disease	C1i, S2b, IC3i
Juvenile Idiopathic Arthritis	C1i, C2j, S2b, S2l, IC3i
Slipped Capital femoral Epiphysis	C1i, IC3i, C4j
Trauma	c2 i, S2b, IC2h
Reactive arthritis	S2b
Transient synovitis	S2b
Idiopathic pain	S2b
Non-Accidental Injury	C2i
Pyrexia of Unknown Origin	C2i
Developmental Dysplasia of the Hip	S2b, IC2 h, IC3i, C4j
Talipes equinovarus	IC2h
Scoliosis	IC2h
Core presentations	
Limping child	S2b, C3d, C2j, C4j
back pain	IC2 h, C3g, IC1i
Musculoskeletal pain	C2j, S2b, C3d
Swollen joint	C2j
Decreased function	C2j, IC1i, C3h
Developmental regression	C3h

Knowledge	
Know about serious and progressive conditions – symptoms, signs and referral pathways	s2, l
List red flags including pain	s1 l, s3 k IC1 h, S2n, C3g, ICi, C4j
Conditions that would affect growth and development	s3, k
Differentiate between adult and paediatric musculoskeletal systems	s1l, C2j
Know about systemic symptoms in conjunction with pain or swelling	IC1 i
Understand about normal MSK development and growth	s2 c , C1 d, C3g, C3h, C4j
Understand about adolescent development	C2j
Know about ranges of movement at joints and when abnormal	C2j, S2l, S2c
Be aware of appropriate musculoskeletal investigations including x-rays	S1l, C1i, S3k, Icih
List a differential diagnosis for MSK presentations	C1i
Understand basic anatomy and physiology of musculoskeletal system in children	C1k, C3h, C4j
Normal variants and when to refer (i.e. abnormal) e.g. fixed flat feet	S3k, Icih, C4j
Know when to reassure and refer	S3k, Icih, C1h
Skills	
Take a detailed pMSK history for aches, pains, limitations, inflammatory symptoms, mechanisms of injury	S1, l c2 i, S2l, C3g
Take pMSK history within systemic enquiry	C2i
Show appropriate approach to pMSK examination – engagement, distraction, observation	S2h, S2m, Se2, C2j, C2i, C3h, Icih
Perform pMSK screening examination	s1 n, C1, I, C3 b, C4j
Recognise common clinical signs related to MSK disease e.g. swollen joint, nail pitting and examine all joints where needed	C1i, C1e, C2j, IC3i, C4j
Formulate appropriate management plan	s1, l
Be able to refer appropriately including accurate descriptions, know when to refer, on basis of GP/FY1	s2, l c1 I, S3 k
Recognise chronic inflammatory conditions	C1i
Assess function in context of MSK disease	C1i, Icti
Differentiate between mechanical and inflammatory conditions	C1i, C2j
Observe gait	C3b, d, IC1h, IC3i, C4j
Recognise the child that has been harmed	C3g, C4j
Summarise and present succinctly, using surgical sieve	C3g, C3h
Detailed pMSK examination	C3g, IC1g, IC3i, C4j

Approach to the child in pain	S1d, IC1h
Assess proximal weakness by jumping	C3g
Assess bony tenderness	IC2i
Attitudes	
Consider social problems in context of MSK disease (c1, i)	C1i
Understand roles within multidisciplinary team	c2 I, j
Consider role of family within consultation	C2i

Table 10 Proposed teaching methods, materials and environments from focus groups

Source coding

- S1, S2, S3 Focus groups with medical students 1, 2, 3
- C1, C2, C3 Focus groups with consultants 1, 2, 3
- IC1, IC2, IC3 Individual interviews 1, 2, 3

Letter following initial code indicates the originating location on the data framework for that item, for example: C1j relates to Focus groups with consultants (1) with item location in framework box j

Methods	Source
pGALS DVD but followed up with clinical teaching	C1 f, j
bedside teaching on pts with or without clinical msk signs	C1 j
Outpatients with designated teaching time students assessing patients before teacher	C1 j, C2 h, S1 m
Follow teaching session with reading material	C1 j
Inclusion in assessment	C1 j
Encourage skill in teaching clinician	C1 j
Student presentations on conditions they may not see on wards	C1 j
Teach on student 'volunteers'	S1m, S3k
Lecture as introduction to what to do	S2m
Discussion about differentials that may not present during teaching	S2b,
Small group interactive sessions	S2h
Registrar teaching then consultant Q&A session	S3l
Consider neuro, developmental and trauma slants to msk	S3l
Teaching materials that help teachers to cover basics	C3b
Structure in age groups	C3i
Systematic approach, framework to assessment	IC1e
Case based teaching	IC1h
Interactive phone consultation e.g. describing x-ray	IC1h
	C4f

Materials	Source
Package like adult GALS with extra text	S1n
Case studies	S1n
Videoed interactive scenarios with facilitator	S1n
Video clips of physical signs e.g. gait analysis, spine examination, inflamed joint swollen joints, limps, gaits, developmental gaits, bizarre gaits and joint positions in chronic pain	C1k C2k C1k
Reusable learning objects – flexible clips	
Blended learning environments e.g. BMJ learning, doctors. net (ideally linked with RCPCH)	C1k
Background reading	C1k
Pre and post teaching MCQs	C1k
Video OSCE	C1k
Mini-CEX	C1k
Outline of anatomy and physiology	C1k
Joint models e.g. of knee normal – abnormal	C1k
Structured learning outcomes (e.g. recognise these, know these in more detail)	S2g
Pictures, x-rays	S3m, IC2k
Handouts useful for revision, summary handouts with key points in hx, exam	S3m, C2k
Video before and after JI – case study	C2k
Web based scenario testing – dynamic self-directed learning	C2k
Video clips of MDT roles	C2k
Pictures or videos of children at different developmental ages	C3j
Cases, picture, DVD, slides – visual resources	IC1k
Referral guidelines	IC2k
DVD of gait, examination	C4l
Environments	Source
Musculoskeletal ward (s1, m)	S1m
Bedside teaching (s1, m)	S1m
Teaching by interested, motivated clinicians (s2, g)	S2g
Teaching by FY1s (s2, g)	S2g
Teaching by other students (s1 h, s2 g, s3)	S1h, S2g, S3
Clinics (s1, h)	S1h
Multidisciplinary meetings (s1, h)	S1h
Stations with MDT members	S3m
Small group interactive sessions (s3, m)	S3m
Nursery school (c3 i)	C3j

Table 11 Barriers from student perspective: to general paediatric and pMSK teaching

Source coding

- S1, S2, S3 Focus groups with medical students 1, 2, 3
- C1, C2, C3 Focus groups with consultants 1, 2, 3
- IC1, IC2, IC3 Individual interviews 1, 2, 3

Letter following initial code indicates the originating location on the data framework for that item, for example: C1j relates to Focus groups with consultants (1) with item location in framework box j

Barriers to general paediatric teaching	Source
Children harder to examine than adults and require different approach/attitude including need for co-operation, understanding behaviour and trusting findings	S1d, S2c, S2f, S3e
Less time teaching on children compared to adults overall	S1d
Lack of reinforcement of theory in clinical practice	S1j
Behaviour of teachers: being ignored, humiliated, given little time	S1i, S2i
Feel less of a team than in adult medicine	S2i
Busy curriculum, pressure on passing exam	S2i
Focus on specialist conditions as opposed to general	S2k
History taking difficult in children	S3b, e
Hard to find patients and ensuring parents present	S3e
Fear of causing pain	S3e
As students less authority than doctors e.g. asking patients to undress	S3e
Barriers specific to pMSK	
Never seen a child having pMSK examination by a doctor	S1d
Importance of pMSK not stressed	S1d
Access to patients: Perceived few acute presentations, few rheumatology clinics	S1d, S2d
Difficult to examine child in pain	S1d
Examination requires cooperation and can cause discomfort, other systems easier.	S2c, d
pMSK History taking different to adults	S2d
Not included in other clinical skills teaching	S2k
Teachers see it as low priority	S1o

Table 12 Barriers from consultant perspective: to general paediatric and pMSK teaching, and to clinicians performing pMSK assessment

Source coding

- S1, S2, S3 Focus groups with medical students 1, 2, 3
- C1, C2, C3 Focus groups with consultants 1, 2, 3
- IC1, IC2, IC3 Individual interviews 1, 2, 3

Letter following initial code indicates the originating location on the data framework for that item, for example: C1j relates to Focus groups with consultants (1) with item location in framework box

Barriers to general paediatric teaching	Source
Teaching focussed on acutely ill children yet consultant work outpatient based	C1h, C2g
No consensus on role of junior doctor and level of knowledge at graduation	C1l
Outpatient clinic often time pressures, may not be good teaching experience	C2h
Med students reluctant to perform examination before doctors	IC1g
Barriers to clinicians performing pMSK assessment	
Will get forgotten if not primary problem	C1c
Unlikely to be performed if no understanding of what examination will show	C1c
Only done when 'has' to be done so no understanding of normal	C1d
Physical signs may be subtle	C1d
Not perceived as core skills like cvs, resp, abdo,	C1b, g, C2d
Lack of recognition that children present with msk problems	C1i
Lack of generic skills enabling gen paed to triage appropriately	C2c
MSK last assessed even if MSK presentation	C2d
General paediatricians lack confidence in pMSK clinical skills	C2d
Paed rheum grew from adult rheum	C2d
Fear of causing pain	Ic1c
Barriers to teaching pMSK	
Overlooked in teaching	C1f
Scarcity of inpatients with msk problems to teach on	C1f
Students keen to learn only if in exam	C1f, C2g, h
Student don't appreciate pMSK burden	C2c
assumption pMSK covered in adult MSK (despite other conditions e.g. asthma not)	C2g
Needs context (IC g)	IC1g
Medical students close in age to teenagers (IC g)	IC1g
Little exposure (IC g)	IC1g
Students have poor basic science knowledge e.g. with X-rays	C4g
pMSK specialists not involved with teaching, general paediatricians not confident in pMSK skills	C2f

Chapter 5 Results Phase 2

5.1 Introduction

In this chapter, results of the Delphi process and the modified Nominal Group Technique will be discussed. The results of the literature review and Phase 1 of this study were used to inform the content of the Delphi process with the aim of deriving consensus on pMSK curriculum content for medical students. At the end of stage 2 of the Delphi process, items with 80% agreement were deemed to be included in the final pMSK curriculum. Remaining items were put to a panel in order to use a modified nominal group technique to achieve final consensus on their inclusion in the final curriculum. The final proposed curriculum can be seen in Table 25.

5.2 Delphi process

5.2.1 Aims and objectives

The aim of the Delphi process was to achieve consensus on pMSK curriculum content using a remote panel of experts.

Specific objectives of the Delphi process were:

- To agree learning outcomes for pMSK clinical skills and knowledge that medical students should attain to be included in a pMSK curriculum
- To achieve expert consensus opinion by appropriate methodology

5.2.2 Results

Experts for the Delphi panel were recruited using purposive sampling as discussed in Chapter 3. A total of 35 clinicians agreed to participate and as outlined in Table 13.

Table 13 Composition of Delphi panel

Specialty	Number	Percentage
Orthopaedics	5/35	14%
Paediatric Rheumatology	7/35	20%
Paediatrics with rheumatology interest	3/35	9%
Paediatrics with 'other' interest	5/35	14%
Paediatrics with education	7/35	20%
Primary care	8/35	23%
Total	35	100%

The Round 1 questionnaire is included in Appendix 7. Learning outcomes (n=51) were listed under the following sub-headings:

- Establishing interaction
- History taking
- Examination
- Investigations
- Formulating a management plan

Additionally, it was clear from the list of suggested pMSK content generated from Phase 1 that students required an understanding of the way in which children present with pMSK pathology and which pMSK conditions this may represent. Core conditions (N=13) and core presentations (N=8) were therefore also included within tables at the end of the learning outcomes. These tables included suggestions for the level of depth that students could be expected to achieve (Table 14).

Table 14 Categories for core conditions and core presentations Round 1 Delphi requiring 'Yes / No' response

Core conditions	Core presentation 'The child with...'
Include in pMSK syllabus	Include in pMSK syllabus
Describe key presenting clinical features & complications	Describe main clinical features
Describe initial management and key investigations	Recognise core conditions associated with clinical presentation
Describe indications for referral	Formulate differential diagnosis
Clinically recognise features of disease	Describe initial management
Other	Other comments to add?

The Round 1 questionnaire was sent by email on 20/5/2008 to all participants. Replies were invited in the following 2 weeks and could be sent by email, fax or post. 33/35 replies were received, giving a response rate of 94%. The Round 2 questionnaire (Appendix 9) was sent on 24/6/2008 to the same participants with the same reply options. Response rate for Round 2 was 34/35 (97%). The overall results of both rounds of the Delphi are outlined in Table 15. The Round 1 questionnaire contained 51 learning outcomes, within the categories shown in the table. At the end of Round 1 5 learning outcomes were accepted and removed from the Round 2 questionnaire. The remaining outcomes were modified, with 10 additional new outcomes from panel suggestions and 2 outcomes resulted from combining original content. There were a total of 47 outcomes in the Round 2 questionnaire.

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Table 15 Results of Round 1 and 2 showing learning outcomes within each section

	Round 1		Round 2			
	Total number of learning outcomes within each section	Number of learning outcomes in each section accepted after Round 1 (>97% consensus)	New learning outcomes added for Round 2 following suggestions in Round 1	Number of learning outcomes modified following suggestions in Round 1	Other	Total number of learning outcomes within each section
Establishing interaction	3	2	1	1		2
History taking	11	0	2	8		10
Examination	20	0	3	15	2 statements combined into 1	18
Investigations	6	0	2	5		7
Management	11	3	2	6	2 statements combined into 1	8
Total number	51	5	10	35	2	47

Statements with universal agreement or comments that did not require action at the end of Round 1 were accepted at this stage and not included in the Round 2 questionnaire (5/51). Using this guideline all points above 97% could be accepted at this stage as statement with lower consensus agreement all required modification. Those statements accepted were the following:

- Establish rapport with child and family 100%
- Relate history and examination findings to core conditions 100%
- Formulate provisional differential diagnosis for core presentations 100%
- Describe MSK presentations of malignancy 97%
- Use appropriate behaviour and language in relation to the developmental stage of the child 97%

A number of modifications and suggestions for new content were suggested by Delphi participants (Appendix 8). These were handled according to the rules proposed by Yeates et al, as discussed in Chapter 3[143]. In this way, all modifications were accounted for by changing the statement referred to, change to a different statement or new statements. Only if the content of the statement was deemed irrelevant to the aims of the Delphi process was it rejected after discussion with the extended research team.

Modifications increased the level of consensus with the exception of three statements as seen in Table 16. Two of these statements retained consensus above 80%. In the remaining statement, concerning proximal myopathy, one fewer respondent agreed with the modified statement leading to the lower agreement (27/33 agreed Round 1, 26/34 agreed Round 2). This statement would be discussed at the NGT meeting in accordance with the established methodology.

Table 16 Statements where agreement decreased between rounds

Section	Round 1 statement	Agreement (%)	Round 2 statement	Agreement (%)
Section 2 Examination	Observe and describe gait pattern	87.9%	Observe and describe principles of gait patterns (e.g. symmetry, leg alignment, presence of pain, limp)	82.4%
Section 2 Examination	Elicit signs of proximal myopathy (e.g. Gower's sign)	81.8%	Elicit signs of muscle weakness and be aware of the possibility of proximal myopathy	76.5%
Section 5 Management	Communicate provisional proposed management plan verbally to child and family	90.9%	Communicate provisional proposed management plan verbally to child and family after discussion with their teachers	88.2%

All other modified statements led to improved agreement. Changes to the statement included modification of the skill expected of the student. An example of this would be **‘Distinguish mechanical from inflammatory musculoskeletal pathology’**. Round 1 gave this a 48.5% acceptance rate. The panel suggested changing ‘distinguish’ to an alternative such as ‘consideration’ or ‘have an awareness of’; acceptance increased to 73.5% by changing to **‘Recognise features in the history that may distinguish mechanical from inflammatory pathology’**. Similarly it was felt by the panel that **‘Include a musculoskeletal history in all history taking encounters’** was unrealistic for students to achieve. The Round 2 statement **‘Include a brief musculoskeletal history in review of systems in all history taking encounters’** increased the percentage acceptance from 85.3% to 100%.

Other changes led to use of specific examples within a statement. In Round 1 **‘Record a full pain history’** received a 66.7% acceptance. Participants requested more detail and expressed uncertainty as to what this entailed. Changing the statement to **‘Elicit and document a pain history (site, character, radiation, aggravating and relieving factors)’** led to universal acceptance of 100% at Round 2.

Statement order was changed in order to make statements more explicit. This led to an increase from 24.2% for **‘Distinguish between benign and non-benign hypermobility (e.g. Marfan’s)’** to 82.4% for **‘Recognise that Marfan’s and Ehler’s Danlos syndromes may be associated with hypermobility’**.

Combining statements occurred where panel suggestions regarding two different statements seemed to express similar concepts. This led to **‘Employ anatomical landmarks in descriptions’** and **‘Use appropriate medical terminology in referral to professional colleagues’** combining to a single statement **‘Use appropriate medical terminology in discussion with professional colleagues including anatomical landmarks where appropriate (e.g. extensor, flexor surfaces, relation to bones, muscles or joints)’** with increase in acceptance from 84.8% / 93.9% to 97.1%.

New statements resulted from new content suggested by the panel, or where a single statement was felt to express too much content. One free-text suggestion led to **‘Summarise key points in the history and examination to form an overall impression of the presentation’** which had universal acceptance in Round 2. The addition of an overall statement regarding development in Section 1 (establishing interaction) allowed later statements to be simplified or combined. This statement **‘Modify history taking and examination according to the child’s developmental stage (e.g. questions about functional activities)’** with

acceptance of 97.1% led to removal of two statements from Round 1 with acceptances of 60.6% and 63.6%.

Responses to core conditions and core presentations had generally high agreement to inclusion with lower percentage agreement to the other categories that attempted to detail knowledge required. Panel comments suggested that there was repetition of the table categories compared to learning outcomes, particularly for presentations when students would be expected to follow history taking, examination, investigations and management as detailed in the previous curriculum content. It was therefore felt appropriate by the research team that these table categories were simplified for Round 2. Core presentations were simply asked to be accepted or rejected. For core conditions, panel members were asked to accept or reject under the following categories:

- Inclusion in the curriculum
- Describe key clinical features
- Describe key complications
- Describe initial approach to management

The conditions and presentations included in the pMSK curriculum at the end of the Delphi process are shown in Table 18 and Table 19. For the core conditions, the revised categories led to greater than 80% agreement in 'describe key clinical features' in six out of the ten conditions accepted. The other categories did not meet consensus agreement.

The content included in Table 17, Table 18 and Table 19 was deemed to be included in the pMSK curriculum at the end of the Delphi process. Content with agreement less than 80% was to be discussed at the NGT meeting.

Table 17 Learning outcomes with >80% agreement after Delphi process

No.	Establishing interaction	Agreement
1	Establish rapport with child and family	100%
2	Respect privacy and confidentiality for the child and family	100%
3	Modify history taking and examination according to child's developmental stage (e.g. questions about functional activities).	97.1%
4	Use appropriate behaviour and language in relation to the developmental stage of the child	97%
	History taking	
5	Record pattern of injury.	100%
6	Elicit and document a pain history (site, character, radiation, aggravating and relieving factors).	100%
7	Identify major milestones within development	97.1%
8	Recognise symptoms such as persistent pain, night pain, fever and weight loss as red flag symptoms for malignancy or significant systemic disease.	97.1%
9	Recognise the need for extended musculoskeletal history in certain presentations (e.g. limp, pain, rashes, refusing to walk)	94.1%
10	Recognise the importance of a full family and social history and their relevance to musculoskeletal presentations.	94.1%
11	Demonstrate awareness of injury patterns suggestive of Non-Accidental Injury.	91.2%
12	Include a brief musculoskeletal history in review of systems in all history taking encounters.	85.3%
13	Use a pain score or simple tools to assess level of pain	82.4%
	Examination	
14	Demonstrate an understanding of ways to engage children when examining to maintain co-operation and minimise discomfort.	100%
15	Demonstrate awareness of developmental staging.	100%
16	Demonstrate the principles of regional musculoskeletal examination incorporating a look, feel, move approach.	100%
17	Recognise that skin and nail abnormalities may be associated with musculoskeletal disease (e.g. nail pitting, rashes).	100%
18	Identify clinical features that suggest an inflamed joint.	100%
19	Perform an examination that screens the musculoskeletal system (e.g. paediatric Gait, Arms, Legs, Spine) understanding that positive findings should lead to more detailed examination.	97.1%
20	Recognise clinical features suggestive of a septic joint and the place of appropriate investigations and referral.	94.1%

21	Demonstrate awareness that a neurological examination may be indicated (e.g. in the context of back pain).	94.1%
22	Describe important neurological associations with back pain such as paraesthesiae and loss of bladder / bowel function.	94.1%
23	Demonstrate awareness that limitation of movement of joints could arise from pathology within the joint, muscle or bone.	91.2%
24	Recognise that normal children have increased joint flexibility compared to adults and may be hypermobile.	88.2 %
25	Assess for scoliosis by inspection and forward bending.	85.3%
26	Recognise that Marfan's and Ehler's Danlos syndromes may be associated with hypermobility.	82.4%
27	Observe and describe principles of gait patterns (e.g. symmetry, leg alignment, presence of pain, limp).	82.4%
	Investigations	
28	Identify the role of blood tests such as FBC, ESR, CRP.	94.1%
29	Discuss results of FBC, ESR, CRP in context of musculoskeletal presentations and potential implications (e.g. raised white cell count and possible sepsis).	94.1%
30	Demonstrate a systematic approach to interpretation of plain X-rays (e.g. of bony fracture).	91.2%
31	Discuss the indications for plain X-ray.	85.3%
	Management	
32	Relate history and examination findings to core conditions	100%
33	Formulate a provisional differential diagnosis for core presentations.	100%
34	Describe musculoskeletal presentations of malignancy such as nocturnal bone pain, swelling, systemic features such as weight loss	100%
35	Demonstrate awareness of the importance of a multi-disciplinary team in managing a child with musculoskeletal disease	100%
36	Summarise key points in the history and examination to form an overall impression of the presentation.	97.1%
37	Use appropriate medical terminology in discussion with professional colleagues including anatomical landmarks where appropriate (e.g. extensor, flexor surfaces, relation to bones, muscles or joints).	97.1%
38	Demonstrate a structured 'surgical sieve' approach to a differential diagnosis (e.g. timing, possible aetiology such as inflammatory, infective, malignancy)	94.1%
39	Outline the principles of managing children with chronic disease (e.g. considering impact on school, play and family, need for medications and monitoring, and the role of healthcare professionals)	91.2%
40	Communicate provisional proposed management plan verbally to child and family after discussion with their teachers.	88.2%

Table 18 Core conditions with >80% agreement following Delphi process

No.	Core condition	Agreement
1	Developmental Dysplasia of the hip	97.1%
2	Septic arthritis and osteomyelitis	97.1%
3	Slipped Capital Femoral Epiphysis	94.1%
4	Bone and joint malignancy	91.2%
5	Juvenile idiopathic arthritis	91.2%
6	Legg-Calve-Perthé disease	91.2%
7	Normal variants (intoeing, knock knees, bow legs, flat feet)	91.2%
8	Common fractures such as forearm, elbow	85.3%
9	Nocturnal idiopathic pain ('growing pains')	85.3%
10	Talipes equinovarus	85.3%

Table 19 Core presentations with >80% agreement following Delphi process

No.	Core presentation (A child with...)	Agreement
1	A limp	100%
2	A swollen joint	100%
3	A fracture	94.1%
4	Multiple swollen joints	91.2%
5	An unexplained fever	85.3%

5.2.3 Discussion

The Delphi process involved a panel of experts within pMSK medicine, paediatrics, education and primary care to arrive at a consensus on content for a pMSK curriculum. This relied on the expert knowledge of the participants, which in this instance refers to shared experience within pMSK teaching. Consensus is able to be attained as pMSK teaching is occurring at present, although no published evidence exists on what this should be. Prior to running the Delphi process an agreed consensus level of 80% was set in order to define curriculum content.

A high panel response rate was seen in both rounds with representation from all key group as previously identified. This was important for the overall study as results needed to represent both pMSK experts and child health education, including primary care. The time period between the rounds was longer than planned at the outset due to analysis taking longer than anticipated. This is reflected in the literature about the challenges of Delphi [151] with a high time commitment required from the research team. However this must be balanced with the low time requirement for participants which is a clear advantage when considering optimising response rate. A pressure for this study was ensuring Round 2 was sent prior to the summer holiday time when many consultants would be away; this was achieved with a resulting good response rate.

Following Round 1, five statements were accepted. These had universal agreement or high agreement with no changes suggested from modifications. This contributed to the rigour of the Delphi process as all statements with suggested modifications were included in Round 2. Only statements with 97% consensus or more were accepted at this stage.

Consensus increased following round 2 in the majority of statements. Where agreement decreased this did not change consensus in two of the three cases. In the third statement the lower agreement resulted from one panel member changing opinion. The Delphi process does not allow for exploration as to why this might be; a simple misunderstanding or disagreement with the statement. This makes statements around the consensus level vulnerable to small changes in opinion; which strengthens the case for a confirmatory stage to follow the Delphi process to allow discussion and clarification. It was reassuring to see consensus increasing in the remainder of the Round 2 content, which is the aim of consensus methodology and reflects the shared view of experts [138, 144, 151].

Modifications took several forms for the Round 2 questionnaire. Change was often suggested in setting the appropriate skill level for each learning outcome. Suggestions from the panel reflected their expert knowledge and realistic expectations for student

learning. By acknowledging and incorporating these suggestions learning outcomes were given more specific skill levels which improved their acceptability. This can only benefit the students and teacher, and indeed was requested in Phase 1 data. As learning outcomes form the main content of a curriculum it was important that they accurately reflected the panel's view of what students should achieve within pMSK medicine.

Clarity regarding the statement content also led to modifications. Inclusion of greater detail or examples led to greater consensus in Round 2. At times panel members expressed uncertainty as to the meaning of the statement. This may be due to ambiguity within the statement, or reflect content out-with their normal practice.

Combining statements also occurred where panel members felt there was repetition. This needed to be done in a way that still reflected the original content alongside any panel suggestions.

New statements were introduced as a result of panel suggestions and related to specific pMSK content as well as general aspects relating to child health such as development. Even though this curriculum is focussed on pMSK medicine it was clearly appropriate to incorporate content related to general child health.

Core conditions and presentations were judged to be important to be included in the pMSK curriculum but the panel could not achieve consensus within the sub-categories. It was felt that for core presentations students should use the learning outcomes to guide their history taking, examination, investigations and management. For core conditions an attempt was made to achieve consensus on the level of knowledge that students should achieve on each. However this did not result in overall consensus opinion which may reflect different practice, panel members' own knowledge, or differences within medical schools. The impetus to ascertain the level of knowledge required on conditions came specifically from medical student focus groups in Phase 1. It may be, however, that in order to fully establish this level of knowledge a different methodology is needed and is not within the scope of this project.

It was important to maintain rigour during the entire Delphi process. From the outset, panel members had personalised contact with their confidentiality assured. All responses were accounted for, with every modification or suggestion recorded (Appendix 8) and managed appropriately [143]. This led to the Round 2 questionnaire containing both modified and statements but this ensured that the final curriculum reflected the expert panel's views and therefore an expert consensus opinion.

5.3 Nominal Group Technique (NGT)

5.3.1 Aims and objectives

The aim of the NGT was to set a final consensus point on pMSK curriculum content using expert consensus opinion.

Specific objectives of the NGT meeting were:

- To review curriculum content with less than 80% agreement following the Delphi process
- To agree on the agreement level above which all content should be included
- To use a structured format that would allow this discussion and achieve consensus from representatives of all key expert groups

5.3.2 Results

The NGT was held on 8/10/2008 and was introduced with a short presentation (Appendix 10).

Table 20 lists the background of all participants. Full results are shown in Table 21, Table 22 and Table 23.

The meeting was not audio-taped but notes were taken by the Chair (SJ) and member of the research team (JS). All voting was recorded both on paper and electronically while the meeting was ongoing.

A challenge for the facilitator (SJ) was to keep the group focussed on the aims of the meeting. This was not an opportunity to change the content of the curriculum as already agreed by the Delphi panel, or indeed to change the methodology of the study. Concerns were raised regarding the length of the curriculum. It was agreed by all that this not the forum for discussing implementation but that this would require careful consideration.

Table 20 Participants for the Nominal Group Technique meeting

Specialty	Number
Primary care	3
Paediatrics	3
Orthopaedics	1
Education	1
Paediatric rheumatology	2
Adult rheumatology (with educational interest)	1
Total	11

Agreement on content to be included in the pMSK curriculum was set at the following percentages:

- Learning outcomes 73.5% *Recognise features in the history that may distinguish mechanical from inflammatory musculoskeletal pathology*
- Core presentations 67.6% *Back pain*
- Core conditions 79.4% *Rickets*

As can be seen from the results table (Table 21), opinions changed between rounds. Participants were asked to focus their discussion on reasoning behind their decision, with particular reference to the needs of their specialty.

Within learning outcomes, discussion arose where participants wished to include an item (Recognise features in the history that may distinguish mechanical from inflammatory musculoskeletal pathology, 73.5%) but exclude an item with higher agreement (Elicit signs of muscle weakness and be aware of the possibility of proximal myopathy, 76.5%). Some participants felt the latter statement was irrelevant, or wished to change the wording. This issue was resolved in three ways and allowed final consensus to be agreed at the level of 73%:

- pMSK specialists in the group argued that the outcome relating to inflammatory pathology of sufficient importance to include all items above it.
- Child health representatives discussed the relevance of including muscle weakness for their specialty and agreed it was appropriate for inclusion; if students were unable to elicit muscle weakness they could miss serious diseases.
- The 'rules' of the meeting were re-iterated; the aim was to ascertain a cut-off point above which all statements would be included and statement would not be modified.

Agreement on core presentations was decided after two rounds. Child health specialists argued that back pain was of sufficient importance to be included due to association with red flag conditions. Other conditions above this were also discussed with pMSK experts describing associated differentials and why this might be important. Final consensus was set at 67.6%.

The final discussion was around core conditions. Three rounds were required here with the orthopaedic representative particularly describing the importance of detecting scoliosis. Child health specialists discussed the importance of rickets as an increasingly common MSK presentation, with relevance also for primary care in recognising this condition promptly and arranging investigation and treatment. This led to group

consensus of 79% and above for core condition, to include scoliosis and rickets. Pulled elbow was felt to be important by one GP present but it was agreed by all present that this could be taught easily in the postgraduate environment.

The final curriculum as verified by the NGT panel comprised 47 learning outcomes, 8 core presentations and 14 core conditions. Items not included are listed in Table 24. While these items have been excluded from an undergraduate curriculum, they may well have significance within postgraduate training. Discussion around these items reflected the specialist skills required to appropriately understand each outcome, condition or presentation. For example, specialist physiotherapists are often involved in the assessment of leg length discrepancy, normal variants of posture and gait analysis. The results of tests such as autoantibodies may require discussion with paediatric rheumatologist and students would not be expected to have a high level of knowledge in this area. It may be of interest to look at these outcomes in conjunction with postgraduate curricula such as that in paediatrics [131].

5.3.3 Discussion

The NGT achieved the aims of setting a consensus level above which all points would be accepted for an undergraduate pMSK curriculum.

A clear strength of the meeting was the opportunity for specialties to explain why items were of importance. This was not specifically in relation to their own practice, but considering the recently graduated student who would be responsible for arranging investigations or referral. Discussion clearly helped to inform the opinion of others and was instrumental in moving the group towards consensus. This would not have been achieved as easily in a third round Delphi.

A further strength of NGT is its structure. Facilitation through the Chair resulted in a timely process, with a focus on output. Strong opinions were presented during the discussion on learning outcome statements but running it as a more informal group meeting would not have moved the group towards consensus quickly. Adhering to the rules of NGT, re-stating the aims of the group, and repeatedly moving the group along, meant consensus was able to be obtained.

One focus of discussion was the desire to change a learning outcome statement to make it more acceptable to the NGT participants. This would have detracted from the rigour of the Delphi process and was therefore not permitted. NGT participants were not on the Delphi panel which may have meant they had less 'ownership' of the data. However it was impractical to bring together the Delphi participants with diverse geographical

locations and the NGT was a pragmatic solution that still provided discussion amongst experts.

Choice of participants was a limitation of this group. In the Newcastle area there were few paediatric orthopaedic specialists, and their presence was therefore not as prominent as had hoped. As explained when discussing the overall methodology (section 3.4.2), this group was only able to include local clinicians which may introduce bias of local practice. Furthermore, no emergency specialists were included in the panel. Their input may have changed the final outcome. For example, 'pulled elbow' is a condition often treated in emergency departments and they may have felt strongly that this should be included. However, this was not raised as essential by any other specialist, in particular by primary care who would often see this condition first. It is likely that the experts present thought that this could be taught within postgraduate training and was not essential for undergraduate knowledge.

This methodology has produced a lengthy curriculum with 47 learning outcomes. Similar studies in undergraduate education have also produced long curricula (Table 3). Within anaesthetics 74 outcomes were proposed [115], whilst dermatology achieved consensus on 53 outcomes [116]. Both propose the teaching of generic skills in other aspects of the undergraduate curriculum and this reflects the difficulty in separating generic and specialty-specific skills when developing educational outcomes. The way in which consensus methods were used in this study led to a tendency for participants to include rather than exclude items. Within the Delphi, the panel were invited to modify outcomes to make them more appropriate for inclusion, and also had the opportunity to offer new suggestions. Similarly, in the NGT, participants were asked to consider all outcomes excluded by the Delphi panel and decide on which should be included. Despite the lengthy nature of the curriculum content, it has been derived using best evidence and consensus and should be seen as the gold standard of pMSK skills, knowledge and attitudes that medical students should attain by the stage of graduation.

5.4 Conclusions to Phase 2

At the end of Phase 2, the proposed content for a pMSK curriculum comprised learning outcomes (n=47), core presentations (n=8) and core conditions (n=14). Consensus on this content was achieved from expert panels using a Delphi process and Nominal Group Technique, and involved representation from all stakeholder groups. The following chapter will discuss possible ways in which this could be implemented.

Table 21 Results of NGT - Learning outcomes

			Round 1	Round 2	Round 3
Management	Plan and discuss a simple approach to the management of pain - use of a pain ladder, reassurance and simple analgesia (including principles of Rest, Ice, Compression, and Elevation).	79.4%			
Management	List specialist opinions that may be necessary for musculoskeletal conditions (<i>e.g. orthopaedics, rheumatology, ophthalmology</i>) and discuss when this may be relevant.	79.4%			
Examination	Demonstrate awareness that leg alignment and foot posture changes with age and normal variants within these – knock knees, bow legs, flat feet, in-toeing	79.4%	GP1, Rh, P	Rh	
Examination	Elicit signs of muscle weakness and be aware of the possibility of proximal myopathy Round 1 Elicit signs of proximal myopathy (Gower's sign) 81.8%	76.5%			
Investigations	Discuss the purpose of other investigations such as CT (to look at bone), MRI (to look at soft tissue) or bone scan (to look for inflammatory disease such as bony metastases or osteomyelitis).	76.5%			
Management	Help medical staff in liaising with other healthcare providers regarding management plan e.g. nursing staff, GP, physiotherapist	76.5%		O	
History	Recognise features in the history that may distinguish mechanical from inflammatory musculoskeletal pathology.	73.5%	GP2, PR1, P2	E, P3, PR1, GP3, P2, P1, GP1	Rh, GP2, PR2
Examination	Assess for leg length discrepancy.	64.7%	O,	GP2,	
Examination	Describe key developmental changes in gait pattern with age from broad based toddler gait to normal gait in childhood	61.8%	E P3, GP3, PR1	PR2	
Investigations	Describe when blood tests such as autoantibodies, muscle enzymes, ferritin are indicated.	58.8%			
Examination	Recognise when patterns of leg alignment and foot posture deviate from normal and may require referral, e.g. non-mobile flat feet.	50%			
Investigations	Discuss positive autoantibody, raised muscle enzymes or ferritin results in the context of musculoskeletal presentations.	35.3%			

Table 22 Results of NGT - core presentations

	Percentage agreement	Round 1	Round 2	Round 3
A swollen joint	100%			
A limp	100%			
A fracture	94.1%			
Multiple swollen joints	91.2%			
An unexplained fever	85.3%	GP2		
Loss of function	79.4%	GP1, P1		
Arthralgia/polyarthralgia	76.5%	E		
Back pain	67.6%	PR1, P3, GP3, P2, PR2	P1, E, GP1, PR1, P3, GP3, P2, PR2, GP1, O, Rh	
Non-organic pain	57.1%	O, Rh		
Regression in motor milestones	50%			

Table 23 Results of NGT - core conditions as agreed by the NGT panel

	Percentage agreement	Round 1	Round 2	Round 3
Juvenile idiopathic arthritis	91.2%			
Septic arthritis & osteomyelitis	97.1%			
Developmental dysplasia of the hip	97.1%			
Reactive arthritis	91.2%			
Legg-Calve-Perthé disease	91.2%			
Slipped Upper Femoral Epiphysis	94.1%			
Bone & Joint malignancy	91.2%			
Multiple fractures including Non-Accidental Injury	91.2%			
Normal variants	91.2%			
Talipes equinovarus	84.8%			
Common fractures e.g. forearm	84.8%			
Nocturnal idiopathic pain (growing pains)	84.8%	P1, GP2		
Scoliosis	79.4%			
Rickets	79.4%	PR2, GP2, GP3, P3, PR1, Rh, O,	E, P1, GP1	GP1
Pulled elbow	70.6%		GP1	
Congenital muscular torticollis	47.1%			

Table 24 Items excluded from the final pMSK curriculum following the NGT

		Consensus following Delphi
Learning outcomes	Assess for leg length discrepancy.	64.7%
	Describe key developmental changes in gait pattern with age from broad based toddler gait to normal gait in childhood	61.8%
	Describe when blood tests such as autoantibodies, muscle enzymes, ferritin are indicated.	58.8%
	Recognise when patterns of leg alignment and foot posture deviate from normal and may require referral, e.g. non-mobile flat feet.	50%
	Discuss positive autoantibody, raised muscle enzymes or ferritin results in the context of musculoskeletal presentations.	35.3%
Core presentations	Non-organic pain	57.1%
	Regression in motor milestones	50%
Core conditions	Pulled elbow	70.6%
	Congenital muscular torticollis	47.1%

Chapter 6 Final curriculum and suggested implementation

This study has developed proposed content for a pMSK curriculum in the form of learning outcomes, core conditions and core presentation. Considerations for implementation include the development of teaching resources, mapping outcomes within general child health or specialty-specific teaching, and mapping core conditions to core presentations. Suggested ways of achieving these are listed in Table 25.

6.1 Teaching resources

During Phase 1, participants contributed suggestions for additional curriculum content such as teaching methods, resources and assessment tools. Each outcome in the curriculum can therefore be linked to a suggested resource as shown in Table 26.

Some of these resources are already in existence such as the pGALS DVD and REMS handbook. Other requires further development such as case studies, clinical photographs and assessment tools. It is anticipated that these could be collated into a ‘toolkit’ to accompany the pMSK curriculum and implementation would include evaluation of this toolkit from students’ and teachers’ perspectives.

6.2 General and specialty-specific outcomes

This curriculum has been developed using rigorous methodology, but the nature of the methods used has resulted in a lengthy content. However, many learning outcomes deemed to be important by the expert Delphi panel reflect generic skills expected of medical students during their child health education. These have been highlighted in Table 25, initially using the researcher’s (SJ) experience in child health education. Comparison has also been made with published outcomes within the General Medical Council’s recently published recommendations for undergraduate education, Tomorrow’s Doctors 2009[172]. This reinforces the generic nature of many outcomes within the pMSK curriculum. For example, Tomorrow’s Doctors specifies that students should be able to ‘Justify the selection of appropriate investigations for common clinical cases’ and ‘Make an initial assessment of a patient’s problems and a differential diagnosis. Understand the processes by which doctors

make and test a differential diagnosis.’ These concepts are reflected in the pMSK curriculum. It will be of interest and value to validate this classification in future work.

By dividing the curriculum in this way, it is proposed that 16 learning outcomes are pMSK-specific as can be seen in Figure 5. Perhaps unsurprisingly, the majority of the specialty-specific items are related to examination (items 5 – 15). Many of these outcomes are covered in the pGALS DVD [90] or share principles with adult MSK medicine such as identification of joint inflammation and muscle weakness. Many doctors involved in the care of children have low confidence in their pMSK clinical skills [28] and this observation was reinforced in the barriers to pMSK teaching identified in Phase 1 (Table 11, Table 12). It may therefore follow that these pMSK specific outcomes are the most difficult ones for general child health teachers to deliver, and this would be of interest to explore in future work, perhaps using qualitative methods. The development of resources for these outcomes to both facilitate delivery of teaching and support students in their learning are likely to be beneficial.

6.3 Mapping core conditions and presentations

The final curriculum details 14 core conditions and 8 core presentations. Certain presentations, such as the child with a limp, will cover many of the core conditions in the proposed curriculum. Only 2 core conditions are not linked to core presentation. Talipes equinovarus is a condition that presents at birth, and is therefore likely to be covered in neonatal or obstetric teaching, which makes curriculum mapping of importance. The final item, normal variants of posture, is not linked to any core presentation. However, this was highlighted during Phase 1 as an important item for inclusion, both from the literature [40] and from focus groups and interview participants (Table 9). Normal variants of posture present often to primary care, and may result in unnecessary referral to paediatric orthopaedics. It is likely that this will need development of a specific educational resource which would ideally have input from relevant stakeholders.

Although 8 core presentations are proposed in this curriculum, there is overlap between them. For example, it would be possible to deliver teaching on the child with arthralgia, single swollen joint or multiple joint swellings in the same session, and achieve discussion on several core presentations (Table 26). Similarly, the child with a limp and loss of function can be taught together. Fracture management will usually occur in orthopaedic or emergency medicine teaching and curriculum mapping will be important to ensure pMSK principles are being taught, including those related to non-accidental injury. The child with a fever is one of

the commonest presentations within both hospital child health and primary care. Again, curriculum mapping will allow pMSK medicine to be included in this.

6.4 Discussion

In order to deliver the proposed pMSK curriculum, ways to assist implementation have been proposed. A 'toolkit' consisting of established and novel teaching resources as suggested by participants in this study is likely to facilitate pMSK teaching, with many resources complementing multiple outcomes. The work in this study provides background and suggested content, with further work required for detailed content and presentation.

Although this curriculum is lengthy in content, many items are generic skills expected of any medical student. This is supported by *Tomorrow's Doctors 2009*. Outcomes which are specific to pMSK medicine relate mainly to examination and it will be important to ensure resources are developed to assist delivery of teaching in this area. Future work should include evaluation of pGALS as a teaching resource and it will also be of interest to see if this improves doctors' confidence in their pMSK clinical skills.

Core conditions proposed in this curriculum can be covered by teaching on core presentations, with the exception of 2 conditions. One (Talipes equinovarus) is likely to be covered elsewhere in the curriculum leaving only one conditions (normal variants of posture) needing specific resources to ensure it can be included in pMSK teaching. Core presentations could be grouped together to facilitate teaching, with the potential for 'swollen joint' and 'limp' to cover many presentations, conditions and outcomes. Curriculum mapping [129] will be of importance to ensure paediatric principles are covered in fracture teaching, and pMSK principles are covered in teaching on the child with a fever.

Future work should look at these areas, with the goal of facilitating deliver of this curriculum in all UK medical schools with appropriate evaluation.

Table 25 Final proposed pMSK curriculum with accompanying suggested teaching resources

Curriculum item	Teaching resource	Generic skill or specialty-specific
Establishing interaction		
Establish rapport with child and family	Generic approach to encounter with paediatric patient Best done by video Discussed in generic paediatric textbooks	Generic
Respect privacy and confidentiality for the child and family		Generic
Use appropriate behaviour and language in relation to the developmental stage of the child		Generic
Modify history taking and examination according to child's developmental stage (e.g. questions about functional activities)		Generic
History Taking		
Record pattern of injury.	Case history – NAI	Generic
Demonstrate awareness of injury patterns suggestive of Non-Accidental Injury	Case history –NAI	Generic
Recognise symptoms such as persistent pain, night pain, fever and weight loss as red flag symptoms for malignancy or significant systemic disease.	Case history – malignancy	Generic
Elicit and document a pain history (site, character, radiation, aggravating and relieving factors).	Case history – chronic pain Development of pain assessment tool	Generic
Recognise the importance of a full family and social history and their relevance to musculoskeletal presentations.	Case history – NAI Case history – chronic pain	pMSK specific
Identify major milestones within development	Video of developmental assessment Photos of key developmental stages	Generic
Recognise the need for extended musculoskeletal history in certain presentations (e.g. limp, pain, rashes, refusing to walk)	Highlighted in cases	pMSK specific
Use a pain score or simple tools to assess level of pain	Case history – chronic pain Pain assessment tool	Generic
Include a brief musculoskeletal history in review of systems in all history taking encounters.		pMSK specific
Recognise features in the history that may distinguish mechanical from inflammatory musculoskeletal pathology.		pMSK specific

Examination		
Demonstrate an understanding of ways to engage children when examining to maintain co-operation and minimise discomfort.	Generic approach to encounter with paediatric patient Discussed in generic paediatric textbooks	Generic
Demonstrate awareness of developmental staging	Video of developmental assessment Photos of key developmental stages	Generic
Perform an examination that screens the musculoskeletal system (e.g. paediatric Gait, Arms, Legs, Spine) understanding that positive findings should lead to more detailed examination.	pGALS DVD	pMSK specific
Demonstrate the principles of regional musculoskeletal examination incorporating a look, feel, move approach.	?pREMS resource REMS handbook Likely to need bedside teaching	pMSK specific
Demonstrate awareness that limitation of movement of joints could arise from pathology within the joint, muscle or bone.	Demonstrated in cases	pMSK specific
Recognise that skin and nail abnormalities may be associated with musculoskeletal disease (e.g. nail pitting, rashes).	Photos of psoriasis/vasculitic rashes (on pGALS, could also be separate resource)	pMSK specific
Identify clinical features that suggest an inflamed joint	Case history – septic joint	pMSK specific
Recognise clinical features suggestive of a septic joint and the place of appropriate investigations and referral.	Case history – septic joint	pMSK specific
Demonstrate awareness that a neurological examination may be indicated (e.g. in the context of back pain).	Case history – back pain	Generic
Describe important neurological associations with back pain such as paraesthesiae and loss of bladder / bowel function.	Case history – back pain	Generic
Recognise that normal children have increased joint flexibility compared to adults and may be hypermobile.	On pGALS DVD Photos demonstrating Beighton's criteria	pMSK specific
Recognise that Marfan's and Ehler's Danlos syndromes may be associated with hypermobility.		Generic
Observe and describe principles of gait patterns (e.g. symmetry, leg alignment, presence of pain, limp).	Observation of gait and description of key stages	pMSK specific
Assess for scoliosis by inspection and forward bending.	pGALS	pMSK specific
Demonstrate awareness that leg alignment and foot posture changes with age and normal variants within these - knock knees, bow legs, flat feet, in-toeing	Photos	pMSK specific

Elicit signs of muscle weakness and be aware of the possibility of proximal myopathy		pMSK specific
Investigations		
Identify the role of blood tests such as FBC, ESR, CRP	Case history – septic joint, malignancy	Generic
Discuss results of FBC, ESR, CRP in context of musculoskeletal presentations and potential implications (e.g. raised white cell count and possible sepsis).	Case history – septic joint, malignancy	Generic
Discuss the indications for plain X-ray. (85.83%)	X-rays with positive findings and accompanying text	Generic
Demonstrate a systematic approach to interpretation of plain X-rays (e.g. of bony fracture).	X-rays with positive findings and accompanying text	Generic
Discuss the purpose of other investigations such as CT (to look at bone), MRI (to look at soft tissue) or bone scan (to look for inflammatory disease such as bony metastases or osteomyelitis).	Slides to accompany case histories	Generic
Management		
Summarise key points in the history and examination to form an overall impression of the presentation.	?Generic skill	Generic
Use appropriate medical terminology in discussion with professional colleagues including anatomical landmarks where appropriate (e.g. extensor, flexor surfaces, relation to bones, muscles or joints).	List of musculoskeletal terminology and definitions with accompanying photos/pictures (e.g. valgus, varus etc)	Generic
Relate history and examination findings to core conditions	Case histories	Generic
Formulate a provisional differential diagnosis for core presentations	Case histories	Generic
Demonstrate a structured ‘surgical sieve’ approach to a differential diagnosis (e.g. timing, possible aetiology such as inflammatory, infective, malignancy etc)	Generic skill	Generic
Communicate provisional proposed management plan verbally to child and family after discussion with their teachers.	Generic skill	Generic
Describe musculoskeletal presentations of malignancy such as nocturnal bone pain, swelling, systemic features such as weight loss	Case history – malignancy	Generic
Demonstrate awareness of the importance of a multi-disciplinary team in managing a child with musculoskeletal disease	Case history- JIA	Generic

Outline the principles of managing children with chronic disease (e.g. considering impact on school, play and family, need for medications and monitoring, and the role of healthcare professionals)	Case history – JIA	Generic
Plan and discuss a simple approach to the management of pain - use of a pain ladder, reassurance and simple analgesia (including principles of Rest, Ice, Compression, and Elevation).	Pain ladder examples	Generic
List specialist opinions that may be necessary for musculoskeletal conditions (<i>e.g. orthopaedics, rheumatology, ophthalmology</i>) and discuss when this may be relevant.	Referral guidance	pMSK specific
Help medical staff in liaising with other healthcare providers regarding management plan e.g. nursing staff, GP, physiotherapist	Generic skill	Generic

List of resources
<p>Generic approach to encounter with paediatric patient - best done by video, discussed in generic paediatric textbooks</p> <p>Case studies focussed on NAI, malignancy, chronic pain, septic joint, back pain, JIA</p> <p>Video of developmental assessment</p> <p>Photos of key developmental stages</p> <p>pGALS DVD + lesson plan</p> <p>pREMS resource</p> <p>REMS handbook</p> <p>Photos of psoriasis/vasculitic rashes (on pGALS, could also be separate resource)</p> <p>Photos demonstrating Beighton's criteria</p> <p>Observation of gait and description of key stages</p> <p>X-rays with positive findings and accompanying text</p> <p>List of musculoskeletal terminology and definitions with accompanying photos/pictures (e.g. valgus, varus etc)</p> <p>Developmental assessment video and photos/descriptions of key stages</p> <p>Observation of gait and description of key stages</p> <p>Pain assessment tool</p> <p>Referral guidance</p>

Table 26 Mapping of core presentations and core conditions with other potential sources of teaching

Core Presentation	Ideas on how this can be taught	Related core conditions	Other sources of teaching
A swollen joint	Case study could include single swollen joint, multiple swollen joint and arthralgia. Would cover wide differential diagnosis.	Juvenile idiopathic arthritis Septic arthritis and osteomyelitis Reactive arthritis Bone and joint malignancy Rickets	Similar principles will be present in adult MSK teaching
Multiple swollen joints	See above	Juvenile idiopathic arthritis Septic arthritis and osteomyelitis	
Arthralgia/polyarthralgia	See above	Juvenile idiopathic arthritis Nocturnal idiopathic pain ('growing pains') Rickets	
A limp	Likely to cover many core conditions and learning outcomes. Case study with different outcomes would be of value to develop. Shared principles with 'loss of function'	Juvenile idiopathic arthritis Septic arthritis and osteomyelitis Reactive arthritis Bone and joint malignancy Developmental dysplasia of the hip Legg-Calve-Perthé disease Slipped Upper Femoral Epiphysis	Limping child presentation may also be covered in emergency medicine or primary care teaching. Already a core presentation in many UK medical schools[72]
A fracture	Should be covered in orthopaedic or emergency teaching	Common fractures such as forearm, elbow Multiple fracture including non-accidental injury	Likely to be covered in orthopaedic and emergency medicine teaching.

Back pain	Red flag condition, teaching needs to include reference to malignancy and sepsis	Bone and joint malignancy Scoliosis Juvenile idiopathic arthritis Septic arthritis and osteomyelitis	Red flag condition. Likely to be covered in primary care and adult MSK teaching but important paediatric factors.
Loss of function (e.g. 'my child won't use his arm')	See 'A limp'	Septic arthritis and osteomyelitis Bone and joint malignancy Reactive arthritis Juvenile idiopathic arthritis	
An unexplained fever	Core paediatric skill that should include reference to pMSK pathology	Septic arthritis and osteomyelitis Bone and joint malignancy Reactive arthritis Juvenile idiopathic arthritis	Likely to be covered in all child health curricula, important to ensure pMSK conditions are covered
Presentations not covered in above		Talipes equinovarus	Neonatal teaching
		Normal variants (intoeing, knock knees, bow legs, flat feet)	Needs specific teaching resource

Figure 5 Learning outcomes proposed to be specific to pMSK medicine

1. Recognise the importance of a full family and social history and their relevance to musculoskeletal presentations.
2. Recognise the need for extended musculoskeletal history in certain presentations (e.g. limp, pain, rashes, refusing to walk)
3. Include a brief musculoskeletal history in review of systems in all history taking encounters.
4. Recognise features in the history that may distinguish mechanical from inflammatory musculoskeletal pathology.
5. Perform an examination that screens the musculoskeletal system (e.g. paediatric Gait, Arms, Legs, Spine) understanding that positive findings should lead to more detailed examination.
6. Demonstrate the principles of regional musculoskeletal examination incorporating a look, feel, move approach.
7. Demonstrate awareness that limitation of movement of joints could arise from pathology within the joint, muscle or bone.
8. Recognise that skin and nail abnormalities may be associated with musculoskeletal disease (e.g. nail pitting, rashes).
9. Identify clinical features that suggest an inflamed joint
10. Recognise clinical features suggestive of a septic joint and the place of appropriate investigations and referral.
11. Recognise that normal children have increased joint flexibility compared to adults and may be hypermobile.
12. Observe and describe principles of gait patterns (e.g. symmetry, leg alignment, presence of pain, limp).
13. Assess for scoliosis by inspection and forward bending.
14. Demonstrate awareness that leg alignment and foot posture changes with age and normal variants within these - knock knees, bow legs, flat feet, in-toeing
15. Elicit signs of muscle weakness and be aware of the possibility of proximal myopathy
16. List specialist opinions that may be necessary for musculoskeletal conditions (*e.g. orthopaedics, rheumatology, ophthalmology*) and discuss when this may be relevant.

Chapter 7 Discussion

7.1 Introduction

The overall aim of this study was to develop pMSK curriculum content for UK medical schools. This has been achieved by combining best evidence and expert consensus to allow development of the learning outcomes and core pMSK knowledge that all medical students should achieve by the level of graduation. In this chapter, the overall study will be reviewed with particular reference to the study's planned outcomes. Key points from the study background, methodology and overall results will illustrate how the study's aim and specific outcomes have been achieved. The overall strengths and limitations will be reviewed before stating the conclusions reached and future directions.

7.2 The need to improve pMSK clinical skills in graduating medical students

The concept for this study arose from observations and published evidence that pMSK clinical skills were poorly done in clinical practice. Doctors involved in the care of children report low self-confidence in their pMSK clinical skills [28] and show poor performance [30]. This is likely to be contributory to the difficulty making diagnoses from pMSK presentations [36, 37, 39, 40] despite the frequency of pMSK disease (Table 1). Clinical implications of this situation are clear; children with pMSK disease such as JIA, cancers and DMD have a delay in referral to specialist care ([43, 46-48, 51, 53] despite the availability of treatment and potential to improve outcome [53, 57, 58, 62, 65, 68].

A lack of pMSK education is likely to be contributory to this delay in accessing care [43, 45, 51, 53, 57, 58, 62, 65, 68]. Doctors involved in the care of children do not recall undergraduate pMSK teaching, which is hardly surprising considering that little pMSK education is included in UK medical schools [28, 72]. Child health leads at UK medical schools perceived pMSK clinical skills to be poorly taught, despite the agreement that they are as important as skills within other bodily systems [72]. Undergraduate education is required to equip medical students with the knowledge, skills and attitudes to be able to competently assess patients and function as a Foundation doctor [85, 86]; pMSK skills and knowledge education must, therefore, be improved at this level.

Interventions to improve general MSK education have been published [77, 78, 96, 101-105]. However, these could not be simply applied to pMSK medicine as the principles of child health such as development and growth needed consideration alongside specific pMSK skills [37, 52, 113]. These two concepts must be included in any pMSK educational intervention to be developed.

In order to influence knowledge, skills and attitudes at undergraduate level, a pMSK curriculum was therefore deemed necessary. A curriculum refers to the educational programme within a specific subject, and in the current medical educational environment is based on learning outcomes [117] which inform the student, teacher, assessor and planner [119]. This study therefore concentrated on development of learning outcomes for pMSK medicine and used consensus methods to achieve this as other subspecialties have done [114-116].

With a clear need established, this study firstly explored pMSK teaching with relevant groups; medical students, teachers and pMSK experts before using consensus methods to achieve the final curriculum content.

7.3 Identify barriers to pMSK teaching from the perspectives of students, teachers and pMSK experts

Focus groups and interviews in Phase 1 of this study produced discussion around pMSK education from the perspectives of those receiving teaching (students), delivering teaching (paediatric teachers) and those with a vested interest in improving pMSK education (pMSK experts). One outcome of this stage was the articulation of barriers related to general child health teaching, or specific to pMSK education (Table 11, Table 12).

The perception that students were worried about the differences between adult and child clinical skills [109] was confirmed in this study. Other general child health barriers which were identified related to the establishment of rapport with children and the fear of examining children in pain. Teachers were keen that these challenges were reflected in any pMSK educational interventions.

Several of the barriers raised in this study as specific to pMSK education are shared with those in adult MSK teaching [82, 106]. These include teachers' lack of time, few inpatients with pMSK disease for bedside teaching, poor anatomical and basic science knowledge in students, and the impact of teachers' low confidence in their

own skills. It was also observed by teachers in this study that pMSK clinical skills were taught less frequently than other clinical skills, which may well be related to the known low confidence doctors have in their own pMSK clinical skills [28] and would be in keeping with the views of child health leads at UK medical schools [72]. The absence of pMSK clinical skills in assessments was perceived to be a barrier. In keeping with the concept that ‘assessment drives learning’ [171] students were seen to be motivated to learn only those skills they would be examined on.

These barriers required acknowledgment and were used to inform the structure and content of learning outcomes. This would then inform the overall curriculum; with appropriate learning environment, teaching methods, teacher support and assessments many of these barriers could be overcome.

7.4 Define pMSK curriculum content from published evidence and opinions from students, teachers and pMSK experts

Curriculum content was developed from proposals either within published literature or from focus groups and interviews held in Phase 1. Within published evidence, pMSK content was included within an adult MSK curriculum [77] and the proposed US undergraduate curriculum [79]. However, neither of these was sufficient to inform the full curriculum for this study. The adult MSK curriculum did not incorporate the views of those involved with paediatric teaching or pMSK experts. As paediatric clinical skills are delivered within hospital child health or primary care, a curriculum needs to incorporate their views. pMSK medicine is different to adult MSK medicine; children are not ‘small adults’ and have different presentations and management of MSK disease, with the impact of growth, development and the family also important to consider [173]. The US curriculum differed in that it was developed with expert teacher input but related only to US medical schools [80]. This is a different educational environment to the UK, based on graduate education and a shorter course. It was not felt appropriate therefore to generalise those findings directly relevance to child health teaching within the UK.

Participants in Phase 1 of this study proposed pMSK teaching content (Table 9). Skills relevant to the newly graduated doctor were deemed to be important by both students and teachers which was in keeping with the GMC’s view of undergraduate education [85]. It was felt that students should graduate with the ability to perform an initial assessment of children with pMSK presentations. Concepts highlighted

within different groups included awareness of ‘red flag’ conditions, knowledge of pMSK specific conditions such as JIA, and understanding of normal development.

Certain proposals took into account the barriers within pMSK teaching, for example it was felt to be important that students learned about establishment of rapport with children and management of pain.

Data generated in this phase were categorised within the skills expected of graduating doctors; history taking, examination skills, investigations and management. An additional heading on establishing interaction acknowledged the child health specific concepts of building rapport and developmental considerations. Knowledge within pMSK medicine was considered within core presentations and core conditions.

Contribution from all stakeholder groups was important for this study to ensure the curriculum represents the breadth and depth of pMSK medicine as stated in Chapter 1. Indeed, the proposed content within this study is greater than that within the recently proposed adult MSK curriculum [77].

From this phase of the study, proposed pMSK curriculum content could be considered within a Delphi process in Phase 2. This replaced the traditional first round Delphi of open-ended questions, but is accepted in the literature as an alternative method [151].

7.5 Achieve consensus from experts on the learning outcomes to be included within a pMSK curriculum

Learning outcomes were constructed by combining the skill, knowledge or attitude proposed in Phase 1 with an appropriate descriptor [117, 119, 124, 125]. Choice of this descriptor was made primarily by the main researcher and required consideration of the skill level expected of a medical student approaching graduation.

Agreement on the learning outcomes to be included within the final pMSK curriculum was achieved by a Delphi process and NGT in Phase 2 of this study. The Delphi process has been widely used in healthcare research for curriculum development [114-116, 140, 148] in order to achieve consensus from a remote panel of experts through an iterative process [138]. Geographical variation was an important consideration to limit local bias and help to ensure the final curriculum could be used by any UK medical school.

At the end of Round 1 of the Delphi process, a small number (5/51) of learning outcomes had sufficiently high enough agreement to be included in the final curriculum. All other statements were put to Round 2 with modifications and new content as suggested by the Delphi panel. These modifications were handled in a structured way [143] to ensure all suggestions were accounted for in the Round 2 questionnaire. This contributed to the overall reliability of the research findings and ensured a rigorous process was followed.

At the end of Round 2, all learning outcomes with greater than 80% consensus were deemed to be included in the final curriculum (n=35). The 80% level was a pragmatic cut-off point that has been used in previously published Delphi studies [115, 143, 153, 154]. To achieve the gold standard of 100% consensus would require multiple rounds which is practically unachievable in a time-limited study that relies on busy clinicians participating in their own time [150, 151]. At the end of the Delphi process therefore the proposed curriculum included 40 learning outcomes.

The remaining items (n=12), along with core presentations and conditions, required further discussion to ensure adequate consideration was given to those being rejected. The NGT allowed further consensus to be achieved in a structured and facilitated way [138, 139] and was felt to be beneficial to a third round Delphi process as discussion could be achieved. Representatives from all expert groups decided on their final cut-off point and shared their reasoning in turn with the other group members. Certain outcomes were of particular importance to different specialties; discussion and clarification of this led to participants changing their decisions with movement towards consensus. This process resulted in agreement on the final outcomes to be included in the final curriculum (7/12) with a cut-off agreement level of 73.5%. Cut-off points were also agreed for core presentations (67.6%, 8/10 included), and core conditions (79.4%, 14/16 included).

7.6 The overall curriculum

The final curriculum comprised 47 learning outcomes for the student at the level of graduation to achieve in relation to a child with a MSK complaint. These were within the following categories:

- Establishing interaction (n=4)
- History taking (n=10)
- Examination (n=16)

- Considering investigations (n=5)
- Formulating a management plan to discuss with their teachers (n=12)

Additional curriculum content agreed were core pMSK presentations (n=8) and core pMSK conditions (n=14).

It was expected that by achieving agreement on the learning outcomes, this would inform other curriculum content [117], for example learning environment, teaching methods or assessment. These will vary between schools, but by providing structured learning outcomes students, teachers and curriculum planners will have a clear idea of what needs to be achieved. Learning outcomes for a pMSK curriculum add to the published literature within pMSK education and incorporate established interventions such as pGALS[90] and the concept of detailed examination using the 'look, feel, move' approach [96]. Early consensus was achieved on items related to general child health principles such as establishment of rapport with children and families, reflecting the importance put on these skills from Phase 1 participants and also in the literature [79, 113]. Content is substantially more than the pMSK content within the proposed adult MSK curriculum [77] which is likely to reflect contributions from child health and pMSK experts who had no involvement in the adult curriculum.

7.7 The study methodology: review and critique

In this two-phase study, the ultimate goal was to seek expert consensus on the learning outcomes to be included in a pMSK curriculum. A clear need for this was established while reviewing the literature. The methods chosen achieved this aim in a timely and structured way. Different undergraduate curricula have developed learning outcomes using consensus methodology [114-116, 148], (Chapter 3). However, unlike the studies based in Scotland [114] and Ireland [115], this study has used UK-wide participants to improve the overall generalisability and has considered the other parts of the curriculum such as teaching methods and environments within Phase 1. Qualitative data generated in Phase 1 has usefully produced insights into the barriers within pMSK teaching which will further inform the wider curriculum.

7.7.1 Study strengths

The first strength to discuss relates to the study participants. Early identification of these groups enabled involvement at all stages. Clear definition between the participants groups was also defined as each offered a different perspective.

Contribution from students was felt to be necessary as they would be the eventual recipients of this curriculum. They therefore had a key role in discussing pMSK education in general, suggesting barriers and proposing pMSK curriculum content. However, they are not 'experts' in either pMSK medicine or child health education and were not included within the Delphi process which required an 'expert panel' [138, 144, 151].

Within other participant groups, strong representation from pMSK specialties was maintained throughout the project. These individuals have a vested interest in promoting pMSK education and are at the receiving end of referrals which may be inappropriate and/or late presentations with established pMSK diseases [43, 46, 48]. Involvement of pMSK experts at all stages from the initial study concept helped with credibility of the study and contributed to appropriate content. Ultimately, this group are also likely to be of significance when considering the next stages of this work in implementation and evaluation.

The final participant group encompassed different child health specialties and representatives from primary care and emergency medicine. All contribute to general child health education, with many of those involved in this study having a major role in planning and delivering teaching. This provided balance to the pMSK experts and ensured the principles of child health were represented in the final curriculum [113], alongside pMSK content appropriate for general doctors involved in assessing children. As most children with pMSK disease will be seen within primary care, general paediatrics or emergency medicine before referral to pMSK specialists the view of these specialties were essential in deciding core skills. By using different participants in Phase 1 compared to Phase 2, this widened the pool of participants generating a spread of opinion. This was particularly important as the study aimed to produce a curriculum applicable to all UK medical schools; a geographical spread of opinions and input contributed to overall generalisability and raised the awareness of pMSK education across a wider range of professionals.

A further strength was the study design. Phase 1 generated qualitative data for use within the Delphi process in Phase 2. Focus groups were particularly important as

they allowed discussion between the participants and drew on ‘group synergy’ [133] to generate ideas and debate opinions. A good example of this occurred where participants from different backgrounds (FG3) compared how a child with a pMSK presentation may be managed differently. This led to their conclusion that students require general skills to be able to assess the child appropriately. Within groups of pMSK experts, agreement over core knowledge and skills was seen during their discussions. Holding focus groups and interviews with different specialties in varying locations generated a spread of ideas to minimise the bias that one specialty or location may have. The opportunity to hold interviews within this phase allowed more focussed discussion where required, and was particularly useful in generating orthopaedic input. Framework analysis [132] was conducted in a transparent and structured manner which allowed clear tracking of all data and added to the overall rigour of the study.

The Delphi process is a well-established method of achieving consensus within healthcare research [138, 144, 149, 151], and has been used to develop undergraduate curricula [114-116]. It was therefore an appropriate choice for this study. By ensuring the process was run in a rigorous manner, the outcome of the Delphi process should be as close to the expert consensus view as possible, and indeed the process showed increasing consensus across the two rounds for the majority of statements. Methods were used to optimise response rate with good effect, a further strength of this study [168-170].

Finally, concluding the study with the NGT allowed a review of the Delphi results [151] which contributed to content validity of the overall product [155]. The opportunity for participants to discuss their specialty’s viewpoint in relation to contentious learning outcomes was a useful and productive outcome of this meeting which led to agreement amongst participants on where the final consensus cut-off point should be. In keeping with consensus methodology, therefore, group expert opinion was used to make this final decision, instead of the researcher deciding this alone.

The final outcome, therefore, was the development of learning outcomes and core knowledge content for a pMSK curriculum using best evidence and expert consensus. Strengths of this product relate to a clearly defined need, participant involvement and study design.

7.7.2 Study limitations

This study was based in Newcastle upon Tyne, where several MSK educational interventions have been developed including pGALS and REMS [90, 96]. There was the potential, therefore, to see a Newcastle 'bias' as local participants may have been exposed to more pMSK teaching than other areas. Taking this into account, other geographical locations were used in Phase 1, and the Delphi process used UK-wide participants but use of more than three centres in Phase 1, and a wider pool of Delphi participants may have helped to reduce the local bias effect further. Bias also needs to be considered in the study design, with all methods being facilitated and analysed by one researcher (SJ). Impartiality was maintained as far as possible, but her training and prior knowledge within pMSK education may have had a bias effect. Attempts were made to minimise this by ensuring analysis was reviewed by others in the research team,

A further geographical criticism related to the choice of focus group location. Newcastle, Birmingham and Glasgow are all established medical schools with academic paediatric rheumatology departments. Indeed, all students had received pMSK teaching, although it is known that this is not universal across UK medical schools [72]. Involvement of a newer medical school or a location without paediatric rheumatology presence may have been more useful. Practically, however, contacts at the chosen locations facilitated organisation of the focus groups, which needed to occur promptly at the start of the study to allow the rest of the methodology to follow.

In relation to study participants, orthopaedic input was limited in Phase 1. Their focus group had to be re-arranged and took place after the Delphi process had started. This was not ideal, as paediatric orthopaedics had a key role within this study as pMSK experts and their input to the Delphi content was essential. Interviews with two orthopaedic surgeons did ensure their contribution, and reassuringly, analysis of the focus group did not reveal any new information. The format of the Delphi process allowed the orthopaedic participants to contribute their suggestions during Round 1, which also helped to limit any effect of this delayed focus group. Despite good presence from other specialty groups such as paediatric rheumatology, primary care and paediatrics, there was limited input from emergency medicine at the focus group stage only. This could have been optimised during the Delphi process. Foundation doctors could have provided useful input in relation to important skills for the newly graduated doctor. They may be a useful population to involve in future work.

Purposive sampling was used throughout this study, with groups and individuals invited to participate due to their background and clinical specialty. Those that agree to participate may see more importance in the subject area than those that refuse, potentially introducing bias ([136, 174]. It was hoped to reduce this by the use of different ways of identifying participants in geographically distinct locations, and ensuring a spread of clinical specialties involved at all stages in the study. However this limitation must be acknowledged.

Consensus methods were used in this study to produce a novel curriculum. Without any evidence-based “gold standard” for comparison, it must be assumed that the ‘expert view’ is correct. The pragmatic acceptance of setting agreement at less than 100% must also be acknowledged as a limitation, as multiple rounds were not possible in this study. Use of the NGT did, however, provide some validity of the Delphi results.

Finally, the limitations of the final curriculum must be acknowledged. Full curriculum content has not been identified within this study as to do this would involve development of teaching resources, assessment tools and suggestions for environment and teaching methods [117-119]. It was not possible to achieve this within the methods and timescale chosen. This does ultimately detract from the proposed content as it will be difficult to implement new learning outcomes without the supplementary materials. However, this must be considered as the next step within this research area.

With 47 learning outcomes identified, there is a clear criticism that this is too lengthy and impractical to include in a busy undergraduate curriculum. Other undergraduate curricula proposed have also been lengthy, which may relate to the difficulty in separating generic and specialty-specific skills. Indeed, several of the outcomes covered in Tomorrow’s Doctors 2009 [172] are reflected in the pMSK curriculum. Curriculum mapping should ensure these outcomes are being delivered, with appropriate resources to ensure any important pMSK aspects are included. For example, ‘Identify the role of FBC, CRP, ESR’ should be covered in many areas of paediatric practice and within a pMSK presentation should alert the doctor to the possibility of infection or inflammation. Of pMSK specific outcomes, many are within the ‘Examination’ category. As this is an area where many doctors are low in confidence [28], it is especially important to provide appropriate teaching support.

Curriculum mapping will be integral to the implementation of this curriculum. To do this will require co-operation of curriculum developers. This may be more achievable if an overall paediatric curriculum was proposed for undergraduate child health teaching in all UK medical schools. pMSK content could then be mapped to this in a transparent way. This is not in existence at present, however, and other ways of implementation may need to be considered such as looking at individual medical school curricula and mapping at this level. Alongside curriculum mapping at undergraduate level, it may also be of interest to look at postgraduate curricula in existence such as the paediatric competency framework [131]. Knowledge, skills and attitudes expressed in this newly developed undergraduate curriculum should be developed further in postgraduate training.

In summary, the main limitations of this study related to geography, sampling of participants, lack of 'gold standard' for comparison and the substantial final curriculum. Steps were made throughout this study to acknowledge these limitations.

7.7.3 Relevance of study methods for other curricula development

The Delphi process used in this study has also been used to develop curricula in other areas, including undergraduate anaesthetics, psychiatry and dermatology [114-116] (Table 3). This study had the added components of focus groups and interviews to generate Delphi content, and the NGT to review the Delphi outcome and set the final consensus point.

Using focus groups and interviews to generate qualitative data in Phase 1 of this study allowed involvement of a wide range of participants and helped to minimise the bias of the researcher with significant background knowledge. This replaced the traditional Round 1 of the Delphi process meaning Delphi participants were only required to complete 2 rounds instead of 3. This may have contributed to the good response rate seen in this study. Students had a positive contribution to make in terms of the wider curriculum including teaching resources and identification of barriers which would be useful for other sub-specialties to consider.

In order to review the results of the Delphi, as suggested in the literature [149, 151], a Nominal Group Technique was held. This had the advantage of providing content validity to the Delphi results and allowed discussion and clarification on the points with low consensus. Alternatives may have been repeated rounds of the Delphi, which would have retained the same expert panel to achieve consensus but with the increased likelihood of responder fatigue. In future curricula development there

needs to be some consideration given to this review of the Delphi results, with a further alternative being focus groups to discuss the final product[151].

The main advantage in using the Delphi method for curriculum development is the ability to utilise a geographically diverse expert panel and achieve consensus in a well-established manner. However in this study a lengthy curriculum has been produced, in line with other studies (Table 3), which may be difficult to implement in an already crowded undergraduate learning environment. A further stage in this study using the expert panel to define generic and specialty-specific outcomes may have been beneficial. This is of importance for future curriculum developers who may wish to define precise additional material for the specialty considered. This would require clear aims and objectives, and may lead to a higher consensus set-point or limited content into the Delphi data sheet. However this has the potential of losing important educational outcomes and these future methodologies would need careful consideration.

7.8 Conclusions and recommendations for future work

Learning outcomes and core knowledge content for an undergraduate pMSK curriculum have been proposed. Development of this content drew on the study's participants' knowledge of UK undergraduate education and took into account barriers they raised. For these reasons, the final pMSK curriculum is designed for UK medical schools specifically, although much of the content will be relevant to other medical education models.

The final curriculum content should ensure that doctors at the level of graduation have the skills to perform the initial assessment of any child with a pMSK presentation. Undergraduate education teaches basic skills which are then built upon in postgraduate education. The eventual aim of teaching pMSK skills at this level is to improve the care of children with pMSK presentations and optimise diagnosis and management of those with pMSK diseases.

Implementation is the obvious next step for this study. In order to achieve this, further consideration should first be given to the other curriculum components. Development of teaching resources may help to overcome some of the barriers raised by this study (Table 11, Table 12) and support teachers with low confidence in teaching pMSK medicine. Examples of resources suggested by teachers and students include audio-visual aids such as DVDs, videos and pictures (Table 10), and ideas of

how these can be used to achieve the learning outcomes can be seen in Table 25. When developing these resources, consideration must be given to their format and how they could best answer the needs of both students and teachers. Assessment tools were also requested and may help to drive learning, and facilitate implementation of the curriculum. Together, the curriculum, resources and assessment tools could be compiled to form a 'toolkit' for pMSK teaching. Further research work is needed to ensure this is appropriate for purpose and meets the needs of those delivering the curriculum.

Curriculum mapping is likely to be essential when considering implementation and pilot work involving a small number of universities is likely to show if this is feasible. This would involve detailed examination of their child health curricula with identification of areas where these pMSK learning outcomes are already being delivered, or where additional pMSK learning outcomes could be achieved. If an overall paediatric curriculum was developed, the pMSK outcomes could then be mapped to this and delivered at all UK medical schools.

Once the curriculum is introduced, evaluation is essential. This could involve pMSK assessment results, audit of teaching practice, or review of teachers' confidence in their pMSK teaching.

Introducing the pMSK curriculum to UK medical schools will require the co-operation of pMSK experts and child health teachers, alongside curriculum developers within universities. Many have been involved in this study and may have an element of ownership in the curriculum and be keen to see it being introduced. However, there may be reluctance to introduce new content into busy curricula and this will be of interest to explore, perhaps involving focus groups and interviews with curriculum planners and leads of undergraduate education. Different medical schools offer different approaches to learning such as problem-based learning or a systems-based approach. This may require development of resources to account for these differences. Overall, the development of this outcome based curriculum, with focus on the skills of the newly graduated doctor, is in keeping with the ethos of 'Tomorrow's Doctors' and it is hoped that this will be advantageous in eventual implementation.

Ultimately, it is hoped that this evidence and consensus-based pMSK undergraduate curriculum will inform pMSK education and delivery at all UK medical schools. By improving pMSK education at undergraduate level, graduating doctors will then be

equipped with core pMSK skills and knowledge. This will hopefully translate into improved confidence and performance within the assessment of children with pMSK presentation. Evidence of this will take time to emerge but will be important to observe, with the potential to repeat some of the studies reviewed within this thesis. The eventual goal of this intervention is to improve the clinical care that children with pMSK presentations and established pMSK disease receive.

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Appendix

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Appendix 1 PIL Interview



Improving paediatric musculoskeletal clinical skills in medical students One-to-one Interview Information Leaflet for Health Professionals

What is the purpose of the study?

Musculoskeletal Problems in children are common (4-15% of school aged children), often benign and self-limiting but can be severe and potentially life threatening. They can be the presenting feature of a variety of problems including malignancy, infection and inflammatory conditions, and diagnosis rests on competent clinical skills by assessing doctors.

Doctors involved in primary and secondary care of children (paediatricians and primary care doctors) report low confidence and show poor performance in their skills in assessing children with musculoskeletal complaints, and report a lack of training at undergraduate level. The aim of this study is to identify the appropriate level knowledge and skills that medical students should acquire in their undergraduate training, and appropriate teaching materials to accompany this.

We are asking you to help us with an interview to look at what a medical student should know about paediatric musculoskeletal medicine, and potential teaching and learning methods to accompany this. This will facilitate teaching and learning within the field of paediatric musculoskeletal medicine and provide the basis for confident and competent assessment by doctors involved in the care of children.

Who is organising and funding the research?

The study is being organised and carried out by

- Dr Sharmila Jandial (Specialist Registrar in Paediatrics and **arc** Research Fellow)
- Dr Helen Foster (Consultant Paediatric Rheumatologist)
- Dr Jane Stewart (Lecturer in Medical Education)
- Dr Lesley Kay (Consultant Rheumatologist)

Dr Jandial, Dr Foster and Dr Stewart are employed by Newcastle University. Dr Kay is employed by Newcastle Hospitals NHS Trust.

The Arthritis Research Campaign is funding this study.

Who has reviewed the study?

This study has been approved by the Newcastle Local Research Ethics Committee and the Newcastle Hospitals NHS Hospital Trust.

What are we proposing to do?

We are seeking to achieve an evidence and consensus base for a paediatric musculoskeletal syllabus, learning outcomes and teaching materials from a variety of 'stakeholders' – paediatric musculoskeletal specialists, primary care doctors, paediatric teachers. We will first seek opinion through focus groups and interviews, and then achieve consensus using a Delphi process.

You will be invited to attend an interview. The interview will last up to 1 hour. It will be conducted by Dr Jandial. It will be used to explore your views on what a medical student should know about paediatric musculoskeletal medicine, and how best that should be taught.

Why do we want participants to sign a consent form?

We would like participants to sign a consent form to show that they have agreed for the interview to be tape-recorded, which will ensure that an accurate record of the interview is taken. Should a participant wish a copy of the transcript of the interview, we will be happy to supply them with one.

Participants will be identifiable on the tape but once the tape has been transcribed and analysed, the audio-tape of the interview will no longer be required and will be destroyed. The transcripts will be destroyed after the statutory time has lapsed as set by the Caldicott Guardian at the Hospital Trust. This is usually 10 years. All audio-tapes will be kept in a secure data-cabinet at the Medical School.

All health care professional or Trust identifiable information will be anonymised in transcripts of the interviews. The identity of the participants and the Trust in which they work will not be identifiable in any oral presentation of the work or any written publications.

If you decide to withdraw at any time, any information you have provided will be destroyed.

What are we going to do with the results of the study?

The results of this study will be published in scientific journals and presented at conferences. We will send you a copy of the results of the study. No details of the health professionals will be identifiable from any of the study reports.

Dr Jandial will be writing up this study to submit as a thesis for a higher degree (MD) at Newcastle University.

Only members of the research team will have access to the audio-tape of the interviews. Newcastle NHS Hospitals Trust is acting as the sponsor of our research. As such, a member of staff from their Research and Development Department *may* ask to listen to an interview audio-tape as part of any Research Governance Audit of our project. They would be doing this to check the quality of any transcripts we have made.

What are the possible benefits and disadvantages of taking part?

We realise that the main disadvantage to joining the study is the time it will take. However, the only notable additional work for each participant who agrees to take part will be the one hour taken up by the interview.

Each participant will be helping us design a learning package in paediatric musculoskeletal medicine that can be used to teach medical students

The results of the study will be used to propose a musculoskeletal learning package that incorporates the views and techniques used by experts in the UK. Such a guide will facilitate improved management for children with rheumatic complaints

The participants will be acknowledged in the publications. Intellectual property for the research will be with Newcastle University.

Contact for Further Information

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Appendix 2 PIL Focus Group

Improving paediatric musculoskeletal clinical skills in medical students

Focus Group Information Leaflet for Health Professionals

What is the purpose of the study?

Musculoskeletal Problems in children are common (4-15% of school aged children), often benign and self-limiting but can be severe and potentially life threatening. They can be the presenting feature of a variety of problems including malignancy, infection and inflammatory conditions, and diagnosis rests on competent clinical skills by assessing doctors.

Doctors involved in primary and secondary care of children (paediatricians and primary care doctors report low confidence and show poor performance in their skills in assessing children with musculoskeletal complaints, and report a lack of training at undergraduate level. The aim of this study is to identify the appropriate level knowledge and skills that medical students should acquire in their undergraduate training, and appropriate teaching materials to accompany this.

We are asking you to help us with a focus group study to look at what a medical student should know about paediatric musculoskeletal medicine, and potential teaching and learning methods to accompany this. This will facilitate teaching and learning within the field of paediatric musculoskeletal medicine and provide the basis for confident and competent assessment by doctors involved in the care of children.

Who is organising and funding the research?

The study is being organised and carried out by

- Dr Sharmila Jandial (Specialist Registrar in Paediatrics and **arc** Research Fellow)
- Dr Helen Foster (Consultant Paediatric Rheumatologist)
- Dr Jane Stewart (Lecturer in Medical Education)
- Dr Lesley Kay (Consultant Rheumatologist)

Dr Jandial, Dr Foster and Dr Stewart are employed by Newcastle University. Dr Kay is employed by Newcastle Hospitals NHS Trust.

The Arthritis Research Campaign is funding this study.

Who has reviewed the study?

This study has been approved by the Newcastle Local Research Ethics Committee and the Newcastle Hospitals NHS Hospital Trust.

What are we proposing to do?

We are seeking to achieve an evidence and consensus base for a paediatric musculoskeletal syllabus, learning outcomes and teaching materials from a variety of ‘stakeholders’ – paediatric musculoskeletal specialists, primary care doctors, paediatric teachers. We will first seek opinion through focus groups and interviews, and then achieve consensus using a Delphi process.

You will be invited to attend a focus group session. The focus groups will run for up to 1 hour. They will be chaired by Dr Jandial.

Why do we want participants to sign a consent form?

We would like participants to sign a consent form to show that they have agreed for the focus group to be tape-recorded. The focus groups are tape recorded to ensure that an accurate record of the participants’ views is taken. Should a participant wish a copy of the transcript of their focus group, we will be happy to supply them with one.

Participants will be identifiable on the tape but once the tape has been transcribed and analysed, the audio-tape of the interview will no longer be required and will be destroyed. The transcripts will be destroyed after the statutory time has lapsed as set by the Caldicott Guardian at the Hospital Trust. This is usually 10 years. All audio-tapes will be kept in a secure data-cabinet at the Medical School.

All health care professional or Trust identifiable information will be anonymised in transcripts of the focus group. The identity of the participants and the Trust in which they work will not be identifiable in any oral presentation of the work or any written publications.

If you decide to withdraw at any time, any information you have provided will be destroyed.

What are we going to do with the results of the study?

The results of this study will be published in scientific journals and presented at conferences. We will send you a copy of the results of the study. No details of the health professionals will be identifiable from any of the study reports.

Dr Jandial will be writing up this study to submit as a thesis for a higher degree (MD) at Newcastle University.

Only members of the research team will have access to the audio-tape of the focus group. Newcastle NHS Hospitals Trust is acting as the sponsor of our research. As such, a member of staff from their Research and Development Department *may* ask to listen to a focus group audio-tape as part of any Research Governance Audit of our project. They would be doing this to check the quality of any transcripts we have made.

What are the possible benefits and disadvantages of taking part?

We realise that the main disadvantage to joining the study is the time it will take. However, the only notable additional work for each participant who agrees to take part will be the one hour taken up by the focus group.

Each participant will be helping us design a learning package in paediatric musculoskeletal medicine that can be used to teach medical students

The results of the study will be used to propose a musculoskeletal learning package that incorporates the views and techniques used by experts in the UK. Such a guide will facilitate improved management for children with rheumatic complaints

The participants will be acknowledged in the publications. Intellectual property for the research will be with Newcastle University.

Contact for Further Information

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Appendix 3 PIL Delphi

Improving paediatric musculoskeletal clinical skills in medical students

Delphi Process, Information Leaflet for Health Professionals

What is the purpose of the study?

Musculoskeletal Problems in children are common (4-15% of school aged children), often benign and self-limiting but can be severe and potentially life threatening. Doctors involved in primary and secondary care of children (paediatricians and primary care doctors report low confidence and show poor performance in their skills in assessing children with musculoskeletal complaints, and report a lack of training at undergraduate level. The aim of this study is to identify the appropriate level knowledge and skills that medical students should acquire in their undergraduate training, and appropriate teaching materials to accompany this.

A questionnaire study is proposed to gather opinion from specialists in musculoskeletal medicine, primary care doctors and paediatric teachers. This will involve an iterative process, involving 2 cycles of questionnaires, and will ultimately provide consensus opinion as to what should constitute a paediatric musculoskeletal syllabus, learning outcomes, and appropriate teaching materials. This will facilitate teaching and learning within the field of paediatric musculoskeletal medicine and provide the basis for more confident and competent assessment by doctors involved in assessing children.

Who is organising and funding the research?

The study is being organised and carried out by

- Dr Sharmila Jandial (Specialist Registrar in Paediatrics and **arc** research fellow)
- Dr Helen Foster (Consultant Paediatric Rheumatologist)
- Dr Jane Stewart (Lecturer in Medical Education)
- Dr Lesley Kay (Consultant and Honorary Senior Lecturer in Rheumatology)

Dr Jandial is employed by South Tyneside NHS Trust. Dr Foster and Dr Stewart are employed by Newcastle University. Dr Kay is employed by Newcastle Hospitals NHS Trust.

The Arthritis Research Campaign is funding this study.

Who has reviewed the study?

This study has been approved by the Newcastle Local Research Ethics Committee and the Newcastle Hospitals NHS Hospital Trust.

What are we asking you to do?

We are trying to establish a consensus of expert opinion through a process called “a modified Delphi technique”. We will ask experts from primary, secondary and tertiary care (termed “stakeholders”) to complete questionnaires about what they think medical students need to know about paediatric musculoskeletal medicine before graduation, and appropriate teaching methods to accompany this.

Stakeholders include Paediatric Rheumatologists, Paediatric Orthopaedic Consultants, Paediatricians with interests in Education, Allied Health Professionals involved in paediatric musculoskeletal care, and General Practitioners..Each expert will be asked to fill in 2 questionnaires over several weeks, and we expect these to take a maximum of 30 minutes to complete.

The questionnaires will consist of proposed content for musculoskeletal syllabus, learning outcomes and proposed teaching materials that have been suggested in a previous part of the study. In the first questionnaire that you are sent, there will be space for you to comment on these proposals, and indicate whether you agree or disagree. The replies from all the participants will be collated and incorporated into a modified version and sent to you again for further comment. In this second questionnaire we would ask you to indicate your agreement or disagreement with each statement. This process will allow us to achieve consensus from a range of professionals.

If you agree to participate, then questionnaire studies will be forwarded to you to fill in. These will be available by e-mail or post. A record will be held by Dr Jandial of questionnaires sent out and the questionnaires numbered to allow monitoring of replies and follow-up. This list of participants will be kept separately from the results and known only by Dr Jandial. All responses will be anonymised in subsequent questionnaires and identity of participants will not be disclosed in any reports and publications.

If you decide to withdraw at any stage, any information you have given will be destroyed.

Why do we want participants to sign a consent form?

We would like the experts to sign a consent form to show that they have agreed to fill in the questionnaires as part of the Delphi process.

All health care professional or Trust identifiable information will be anonymised in further analysis. The identity of the health care professional and the Trust in which they work will not be identifiable in any oral presentation of the work or any written publications.

What are we going to do with the results of the study?

The results of this study will be published in scientific journals and presented at conferences. We will send you a copy of the results of the study. No details of the experts will be identifiable from any of the study reports.

Dr Jandial will be writing up this study to submit as a thesis for a higher degree (MD) at Newcastle University.

Only members of the research team will have access to the questionnaires.

What are the possible benefits and disadvantages of taking part?

We realise that the main disadvantage to joining the study is the time it will take. However, the only notable additional work for each expert who agrees to take part will be the 30 minutes to fill in the questionnaires.

Each participant will be helping us design a paediatric musculoskeletal teaching 'toolkit' incorporating syllabus, learning outcomes and teaching materials that can be used to teach all undergraduate medical students.

The participants will be acknowledged in the publications. Intellectual property for the research will be with Newcastle University.

Contact for Further Information

The Principal Investigator, Dr Sharmila Jandial, can be contacted at:
Department of Paediatric Rheumatology
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Appendix 4 Consent form Interview



Consent Form for Health Professional

One to one Interview

Improving paediatric musculoskeletal clinical skills in medical students

NOTES FOR HEALTH PROFESSIONAL

1. We are asking your permission to help us with a research study. This has been explained in the information leaflet which you should have received. This information leaflet is for you to keep and refer to. ***Please read it carefully.***
2. Please ask the principal investigator (Dr Sharmila Jandial) any questions that you may have about this project before you decide whether you wish to take part.

	Please initial the box if you agree
I _____ agree that the Research Project entitled “ Improving paediatric musculoskeletal clinical skills in medical students ” has been explained to me. I have read both the notes written above and the Information Sheet given to me and understand what the research study involves.	
I agree to participate in an interview.	
I understand I can chose to withdraw from the process at any time.	
I understand that if I withdraw from the study at any time, any information I have provided will be destroyed.	
I understand that the transcripts will be kept securely for 10 years after transcription according to the Caldicott guidelines, before being destroyed.	
SIGNED _____	
DATE:	

Appendix 5 Consent Form Delphi

Delphi Process

Improving paediatric musculoskeletal clinical skills in medical students

NOTES FOR HEALTH PROFESSIONAL

1. We are asking your permission to help us with a research study. This has been explained in the information leaflet which you should have received. This information leaflet is for you to keep and refer to. ***Please read it carefully.***
2. Please ask the principal investigator (Dr Sharmila Jandial) any questions that you may have about this project before you decide whether you wish to take part.

Please initial the
box if you agree

I _____ agree that the Research
Project entitled “**Improving paediatric musculoskeletal clinical skills in
medical students**” has been explained to me. I have read both the notes written
above and the Information Sheet given to me and understand what the research
study involves.

☐

I agree to fill in the questionnaires.

☐

I understand that my responses will be anonymised

☐

I understand I can chose to withdraw from the process at any time and
any information I have supplied will be destroyed.

☐

SIGNED

DATE:

Appendix 6 Framework matrix for student focus groups

	demographic data	current pMSK teaching				
		experience to date	perception of pMSK teaching	barriers to learning pMSK	experiences of adult msk teaching	other & gen barriers to paed
newcastle	4/10/07. Clinical learning centre RVI. 6 students, final year, doing paediatric attachment. 5f, 1m	1. 3 shakes of head (1) 10 min quick briefing pGALS not on kids (1), run through (2) and on each other, can't remember how to do it now. Told to look up paediatrics at adult teaching (2)	(teachers) wanted to tick box. not big day. Heard it's different (2)	never seen child examined by doc (msk) (3). Importance not stressed, get away with it by not teaching it (3), mentioned very briefly. Doesn't present acutely so less of an issue to teachers(3). Examining someone in pain - easy to listen with stethoscope but harder get them to walk, move joint. worse in kids (12). Kids harder to examine (12)	really good teaching on adult msk, clear time for examinations and understanding findings (6). Small group teaching, good to see pts with signs 'see what abnormal is'(6). Some taught better than others like hips and knees rather than shoulders (7), depended on specialty of teachers and patients. teaching useful for GP, able to examine decently (8, 9, 10)	oncology teaching bizarre, more useful to do msk. More likely to get msk in exam (3)
birmingham	1/11/07. Birmingham Children's Hospital. Final year medical students. 4 f, 3m.	DVD in intro pack, some small group teaching with cons & rheum clinic seeing pts before cons then going over findings (2). Useful on real pts with prob, helpful to see what looking for, how to handle kids (2). Lecture for whole grp on screening exam, case studies rushed but useful, can then examine a child knowing bit of what to do (4). Lecture good but need chance to practise (3). Core conditions - painful swollen joints, differential of JIA, reactive arthritis, idiopathic pain, limp, TS, DDH, Perthes, SUFE, painful limb, osteomyelitis, septic arthritis, #s, sickle cell (13)	feel it is different how you approach them and bend them, lot more flexible than old people(2). Have to be aware can cause discomfort and kids react differently to adults (3). Used to examining adults and know what is normal but with kids more bendy and flexible...is this normal? don't want to hurt them but got to get a good assessment (3)	kids can say 'forget it you are not touching me any more' (3). With pmsk you are dependent on asking kids to do things for you whereas in cardio to assess it you can just listen to their heart sounds (3) if they are scared of you, you know they are not going to do it (3) . No inpatients, easy to go bedside and examine cvs but not many rheum inpatients (5). If no rheum clinics no exposure (5). If in adult mode history taking might miss symptoms (pain/stiffness as opposed to using limb) (17). Do cardio and resp so often but not msk - need more teaching (18)	yr 4, 2 wks rheum & 2 wks ortho (1). Physio teaching useful, in good position to teach in it but only if lucky enough to get it (11). If more confident in adults would have more confidence in children (18). Less confident as less teaching in adults (19), dependent on hospital (19) - inconsistency.	paeds different - how you approach them, tell them what you are doing, what to expect(3). Paeds..the way you approach the examination is completely different from adults (3). Half the battle is learning how to act around kids (3) - from being around kids and practising (3). Paeds completely new, feel like back in yr 3, don't know how to act around kids (19)

glasgow	04/02/2008. Glasgow University Medical School. Final year medical students. 2m, 3f	registrar teaching on MSK and GALS. 4 x 1 hr sessions on paed ortho: limping child, normal variants, red flags, clinical scenarios (1, 2).1 hr session on rheumatology. One session on examination with pt (11)	paed orth - best ortho teaching had (2). Good because things covered from every angle(2). Good to have session on examination and spend time on something normally glossed over (11). History raking difficult, need to ask leading questions, prob missed stuff (15)		Formal GALS session then peer GALS session. Problem with GALS is times when you need to examine a specific joints (7)	more difficult getting the history, all over the place (11-12). Hard to find pateints and vene harder making sure parents are there (12). Volume of students and content (13). Examination harder - don't trudt findings then harder when wriggling or can't give specific instructions. Parents watching, don't want to hurt (13), Fear of missing something...feel you're cutting back on things (13). Feel as student can't undress them completely, don't have the authority, don't 'have to do it' as student cf doctor (14)
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	experiences of teaching				
	good experiences - teachers	good experiences - methods	bad experiences - teachers	bad experiences - methods	other
newcastle	<p>clinicians keen, wanted us to learn, chance to practise, all got hands on experience (adult msk) (7). Some teachers want to teach more than others. Friendly, suggest improvements in encouraging way (26).</p>	<p>more useful to see it done in practice. Remember if see patients, experience to link (11). Look something up after seeing pt with it. Case studies - core conditions. Systems teaching sessions, history and exam with doc then discuss. Students doing case presentations on core conditions to small groups - give peers more respect than teachers. Clinics - realise impact conditions have on their lives, things sink in (22). See pats before doc (23). MDT meeting where docs explain (23), feel involved. See F3</p>	<p>go away and read about it - not many do, if you read it not likely to know what to do when see pt (4). lack of enthusiasm, 'didn't want to be a teacher' (10). Docs in clinic weren't expecting students, didn't teach 'go and look it up' (24). MDT meetings not expecting students. Teachers that humiliate - unpleasant (26).</p>	<p>reading things only useful if reinforced by seeing patient (5). Presenting to year group in lecture theatre, nobody was listening. Adult msk - 20 pts with rare conditions, not enough time to clerk and examine, didn't remember anything (21). Clinics - Sitting in - comfortable situation, don't have to engage, not interacting (23). Better than reading a book but not as good as clerking. Ignored. not taught (24).</p>	<p>DVD somewhere in between reading and patients (5), easier to visualise than book, not as good as doing it Transcribed from GALS CD and read from that (10). Exam generally harder in kids(12)</p>
birmingham	<p>teacher who is interested & wants to teach, makes you feel involved (e.g. in clinic), being shown how to examine then getting to speak to and examine pts in front of him (8) Teacher who know exam and teaches that, helps you pass your exam (9). Someone watching you and saying how to do things correctly, push/pull in right way (10).). Being taught by FY1s, all just done exams so know what's needed, gave us tips (20). Learning from each other sometimes better, less inhibited (20)</p>	<p>useful to watch what other people do...how doc deals with distressed child - stopping, making it fun, using parents ...then pick out what you think works and see kids yourself, try it out (3). BLS - had lecture then practice on mannikins, helps you cement it in (4). Lecture useful as not going to see all conditions, having discussion about differentials from picture on screen (4), remember it better than reading in a book (5). DVD - useful to see how to orientate child, can learn from seeing someone doing it (10). If you've seen a pt with a problem have context next time you see that problem (12)</p>	<p>everyone seems really busy (6), attached to firm so can't go to other clinics and step on their territory (6), they want you to get to know firm and be part of team but not placed on ward, not seeing same patients - different to adult med where felt part of firm and team (7) BARRIER WITHIN PAEDS. Not knowing learning outcomes and not using them in teaching (9). Consultants sometimes make you feel stupid (20). They need to know what is needed to pass exams (20)</p>	<p>yr 3 told to examine pts, didn't know what to do, no pre lectures (5). By final year don't want to sit in clinic and watch - exception in specialist clinics e.g. cochlear implant (8). DVD - 2 watched it and found it very useful, 2 haven't watched it (10). No consistency on what is being taught (11)</p>	<p>session on paed examination in first week on neuro, cardio, resp, abdo, no msk (5). Not getting enough general paediatrics, everything specialised (7) but those in DGH get all general no specialty (7) Pressure on getting through block and passing exam - lot to learn in short time (11). Too much expected of them in paediatrics, end up doing a lot in inefficient manner (13)</p>

glasgow	if teachers enthusiastic you learn more (3).	clear and defined learning objectives, succinct and interactive, topic covered from different angles and revisited things. Teaching well organised (3). Interactive (3). Peer teaching relaxed, performing in front of consultant more stressful (5). Liked peer led teaching, wish did it more often. Peer teaching good for reinforcing but consultant teaching more reassuring (6).		informal lecture with no slides - harder to take things away (9), too quick to take notes (10). Presentations to peers - no-one turned up, some groups went into too much details, depends on presenting (24 - 25). DVD - wouldn't necessarily watch it (26).	
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	Proposed pMSK teaching			
	content	teaching methods	teaching materials	other
newcastle	Relevany msk history, core conditions, investigations, management, referrals. Differences between paed & adult exam. Formulate a management plan. Know main conditions. Recognise worrying signs (17). Spetic arthritis, cauda equina (18)	see it done in practice, distraction techniques, ranges of movement, esp small children (4). msk ward, see pts (6).. Bedside teaching (13). Presentations to peers on conditions not in ward (18). Docs needed to facilitate - know in practice (20).Clerking patients and presenting to doctors (21). See pts in clinic before doc (23).	package put together like adult GALS, see how supposed to do it (4). Adult msk easiest to revise because of CD (11). May need more than cd (text) (11). CD alone not enough - need to know why you're doing what (11). Case studies (13). Videoed interactive scenarios with facilitator. (13). CD (26)	Teachers make it priority (18)
birmingham	need to know enough for the bais of GP & F1, know when something is serious or not (12) do good screen, recognise conditions, get help, know when to refer (12) Be 'safe' - know serious and progressive diseases e.g. septic arthritis, malignancy - know symptoms, signs and referral path (12). . Need to know about limp and arthritis (14). Differences in histories - children don't complain of stiffness (17). Knw about ligamentous laxity (18)	In adult teaching can show on 'volunteers' (10). See I4 re clinics.	Learning outcomes more structured 'recognise these things, know these in more detail, know these really well' (15) - would then need to know well examination, arthritis, basic first aid of #s, common or dangersous conditions like septic arthritis, malignancy, night pai. Know less about vasculitis, Kawasakis, HSP (16)	could do option (6). 'If I was to get a paed FY1 job I want to know what I am doing, I know tha passing my exaam is a marker of how good I will do that' (9). As an F1 if you diagnose rarity not going to treat it so irrelevant to know that (12) Can't become experts in everything (14) Have learning outcomes - will work hard to learn it all and when you become an F1 actually we will have some remnants of what we have learnt in the back of our minds, superficial grasp of certain conditions (14)

glasgow	<p>show normal variants then the abnormal and show why abnormal e.g. flat foot - good way of relating the 2 (3). Things that shouldn't miss, or be able to reassue (3) like osteomyelitis, septic joint, tumour (15, 16). Red flags , things that will affect child's growth, devpt (16). Red flags for tumour, trauma, inection, inflammation (16). Key red flag points in history (16), 5 's's - symmetry, systemic symptoms, swelling, site, stiffness (16). Basic investigations e.g. blood tests, xrays, what investigations are appropriate for conditions (19). Know where to refer - physio, rheum, ortho(19)</p>	<p>Best way to remember things is to see them e.g. pt with swollen knee (23). Small group interactive sessions (23). Presentations to peers can be good but could be extra work didn't really have to do (24). Anything interactive is better than lecture (25). Registrar teaching on what they thing we should know, what comes up, what their consultant thinks is important, Q&A session with consultant at end of block on important things (25)</p>	<p>pictures, DVDs, xrays next best thing to patients (23). Core material on presentations (23). Handouts useful for revision (26) On-line elarning (26)</p>	
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Appendix 7 Delphi Round 1 data sheet

Sent to participants 20/5/08

Please return within 2 weeks:

By email to Sharmila.jandial@ncl.ac.uk

by fax to 0191 222 5455

by post to Dr Sharmila Jandial, Musculoskeletal Research Group, 4th Floor Catherine Cookson Building, Medical School, Newcastle University NE2 4HH

Delphi Questionnaire Round 1

Paediatric musculoskeletal medicine for medical students

Many thanks for agreeing to participate. Your input, time and comments are gratefully received and appreciated. Although this questionnaire looks long, please be reassured it should take you no longer than 10 minutes to complete!

The following statements relate to the standards expected of a final year medical student at the level of graduation, standards that they could be examined on at final examination. The results will be used to compile a syllabus for undergraduate paediatric musculoskeletal (pMSK) medicine, with suggested learning outcomes.

Please read each statement carefully, relate it to what you would expect of a medical student at the level of graduation and then proceed with **one of 3 options by indicating in the box provided:**

1. **Yes** = this statement content should be included
2. **No** = this statement content should not be included in this format
3. **Modify** = if this statement needs modified. The text box will expand with your text if you are editing electronically. Also use this space to add additional statements or comments.

All responses will be anonymised, we ask for your position for coding purposes only. This study has had full ethical approval.

All responses will be collated and a second questionnaire will be sent to you in 2-3 weeks, your swift response is very much appreciated to allow this to happen.

Specialty	Please tick
Orthopaedic surgeon	
Paediatric Rheumatologist	
Paediatrician with interest in rheumatology	
Paediatrician	
GP	

Section 1

On **establishing interaction** with a child with a musculoskeletal complaint, a medical student at the level of graduation should be able to:

Establish rapport with child and family

Yes ☐ No ☐ Modify

Use appropriate behaviour and language in relation to the developmental stage of the child

Yes ☐ No ☐ Modify

Ensure privacy and confidentiality for the child and family

Yes ☐ No ☐ Modify

Additional statements and further comments on establishing interaction?

Section 2

In **History taking** from a child with a musculoskeletal complaint a medical student at the level of graduation should be able to:

Record pattern of injury with awareness of non-accidental injury

Yes ☐ No ☐ Modify

Distinguish mechanical from inflammatory causes of musculoskeletal pain

Yes ☐ No ☐ Modify

Demonstrate awareness of developmental considerations when asking about inflammatory symptoms (*how does a 4year old communicate morning stiffness?*)

Yes ☐ No ☐ Modify

Recognise red flag signs and symptoms such as night pain, weight loss, fever

Yes ☐ No ☐ Modify

Review functional limitations taking into account the child's developmental stage

Yes ☐ No ☐ Modify

Record a full pain history

Yes ☐ No ☐ Modify

Assess level of pain

Yes ☐ No ☐ Modify

Relate social history to musculoskeletal complaint (*e.g. back pain in dancer, muscular pain in child bullied at school*)

Yes ☐ No ☐ Modify

Record a developmental history

Yes ☐ No ☐ Modify

Recognize the importance of a full family and social history

Yes ☐ No ☐ Modify

Include a musculoskeletal history in all history taking encounters

Yes ☐ No ☐ Modify

Further comments on history taking?

Section 3

In the **examination** of a child with a musculoskeletal complaint a medical student at the level of graduation should be able to:

Employ distraction techniques to maintain co-operation

Yes ☐ No ☐ Modify

Demonstrate awareness of developmental staging

Yes ☐ No ☐ Modify

Perform a musculoskeletal screening examination (e.g. pGALS)

Yes ☐ No ☐ Modify

Perform appropriate musculoskeletal regional examination

Yes ☐ No ☐ Modify

Recognise leg alignment at different ages and normal variants within this (*e.g. knock knees, bow legs*)

Yes ☐ No ☐ Modify

Recognise when 'normal variants' require referral (*e.g. fixed flatfeet*)

Yes ☐ No ☐ Modify

Perform assessment of full ranges of movements at all joints

Yes ☐ No ☐ Modify

Elicit abnormality within range of movement at any joint

Yes ☐ No ☐ Modify

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Describe increased flexibility of children's joints compared to adult

Yes ☐ No ☐ Modify

Recognise hypermobility (*benign*)

Yes ☐ No ☐ Modify

Distinguish between benign and non-benign hypermobility (*e.g. Marfan's*)

Yes ☐ No ☐ Modify

Recognise common skin associations with musculoskeletal disease (*e.g. nail pitting*)

Yes ☐ No ☐ Modify

Identify an acutely inflamed joint

Yes ☐ No ☐ Modify

Recognise clinical features that differentiate between septic and inflammatory causes of joint swelling

Yes ☐ No ☐ Modify

Elicit the clinical features of non-infectious causes of bone and joint pain / swelling (*including inflammatory, rickets, malignancy*)

Yes ☐ No ☐ Modify

Observe and describe gait pattern

Yes ☐ No ☐ Modify

Describe gait pattern at different developmental stages

Yes ☐ No ☐ Modify

Perform a neurological examination in the context of back pain

Yes ☐ No ☐ Modify

Describe important neurological associations with back pain

Yes ☐ No ☐ Modify

Elicit signs of proximal myopathy (*e.g. Gower's sign*)

Yes ☐ No ☐ Modify

Further comments on examination?

Section 4

In considering **investigations** in a child with a musculoskeletal complaint a medical student at the level of graduation should:

Identify when blood tests such as FBC, ESR, CRP are indicated

Yes ☐ No ☐ Modify

Interpret results of FBC, ESR, CRP in context of musculoskeletal presentations

Yes ☐ No ☐ Modify

Discuss when blood tests such as autoantibodies, muscle enzymes, ferritin are indicated

Yes ☐ No ☐ Modify

Interpret positive autoantibody, raised muscle enzymes or ferritin results in the context of musculoskeletal presentations

Yes ☐ No ☐ Modify

Differentiate the role of different radiological investigations such as plain X-ray, CT, MRI

Yes ☐ No ☐ Modify

Explain the indications for and purpose of a bone scan

Yes ☐ No ☐ Modify

Further comments on investigations?

Section 5

On **formulating a management plan** for a child with a musculoskeletal complaint a medical student at the level of graduation should:

Employ anatomical landmarks in descriptions

Yes ☐ No ☐ Modify

Relate history and examination findings to core conditions

Yes ☐ No ☐ Modify

Formulate a provisional differential diagnosis for core presentations

Yes ☐ No ☐ Modify

Describe musculoskeletal presentations of malignancy such as nocturnal bone pain, swelling, systemic features such as weight loss

Yes ☐ No ☐ Modify

Plan management of pain (pharmacological and non-pharmacological)

Yes ☐ No ☐ Modify

Use appropriate medical terminology in referral to professional colleagues

Yes ☐ No ☐ Modify

Describe when appropriate specialist opinion is necessary (*e.g. orthopaedics, rheumatology, ophthalmology*)

Yes ☐ No ☐ Modify

Communicate provisional proposed management plan verbally to child and family

Yes ☐ No ☐ Modify

Liaise with other healthcare providers regarding management plan e.g. nursing staff, GP

Yes ☐ No ☐ Modify

Describe the roles of the multi-disciplinary team in managing a child with musculoskeletal disease (*e.g. physiotherapist, occupational therapist, specialist nurse, psychologist*)

Yes ☐ No ☐ Modify

Outline the principles of managing children with chronic disease

Yes ☐ No ☐ Modify

Further comments on management?

Section 6

For the following tables we wish to ascertain the level of knowledge a students should have about these musculoskeletal conditions and presentations. Please indicate if the condition or presentation should be included in a paediatric musculoskeletal syllabus, and then what level of knowledge you think is necessary for a medical student to demonstrate at the level of graduation.

Insert 'y' (yes) if you agree, 'n' (no) if you disagree

Please return within 2 weeks:

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by fax to 0191 222 5455

by post to Dr Sharmila Jandial, Musculoskeletal Research Group, 4th Floor Catherine Cookson Building, Medical School, Newcastle University NE2 4HH

Core conditions	Include in pMSK syllabus	Describe key presenting clinical features & complications	Describe initial management and key investigations	Describe indications for referral	Clinically Recognise the features of disease	Other
	Y / N	Y / N	Y / N	Y / N	Y / N	Free text
Juvenile idiopathic arthritis						
Septic arthritis						
Osteomyelitis						
Reactive arthritis						
Developmental dysplasia of the hip (DDH)						
Legg-Calve-Perthe disease						
Slipped Upper Femoral Epiphysis						

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Core conditions	Include in pMSK syllabus	Describe key presenting clinical features & complications	Describe initial management and key investigations	Describe indications for referral	Clinically Recognise the features of disease	Other
	Y / N	Y / N	Y / N	Y / N	Y / N	Free text
Bone and joint malignancy						
Scoliosis						
Common fractures such as forearm, elbow						
The child with multiple fracture including non-accidental injury						
Normal variants						
Rickets						
Other?						

Please insert any other comments or modifications to core conditions here:

Please return within 2 weeks:

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Core presentation 'The child with...'	Include in pMSK syllabus	Describe main clinical features	Recognise core conditions associated with clinical presentation	Formulate differential diagnosis	Describe initial management	Other comments to add?
	Y / N	Y / N	Y / N	Y / N	Y / N	Free text
A swollen joint						
Arthralgia/polyarthralgia						
A limp						
A fracture						
Muscular pain (widespread)						
Back pain						
An unexplained fever						

Regression in motor milestones						
Other?						

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Please insert any other comments or modifications to core presentations here.

Any other comments on the paediatric musculoskeletal clinical skills and knowledge that a medical student should have by the level of graduation are appreciated and can be entered here.

Thank you for taking the time to fill this in. Your comments and opinions are very much appreciated and valued. The results from this questionnaire will be collated and summarised, and returned to you in the second questionnaire for your final opinion on inclusion in the next few weeks. I hope this is acceptable for you, please let me know if unable to help at that stage.

Sharmila Jandial, **arc** Educational Research Fellow

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Appendix 8 Modifications and suggestions from Delphi 1

Interaction

Question 1 100% *accepted and removed*

Question 2 97% *accepted and removed*

E24 Avoid language and behaviour so inappropriate to development as to upset child this could be incorporated into teaching materials. This is a specific behaviour that is implied in the general statement

Question 3 (ensure privacy and confidentiality for child and family) 93.9%

E27 be aware of privacy and confidentiality

RI14 'Respect' not ensure as they may not have complete control over the environment

Changing to respect will take into account both of the above comments

Comments - interaction

P18 Unless rapport established with child & family any examination findings may be compromised by lack thereof

This is in support of statement inclusion

P17 Essential to identify pain before examination

Will be acknowledged in later statements in history

History taking

Question 4 (record pattern of injury with awareness of NAI) 87.9%

O4 Limited perhaps to appreciation that long bone fractures say of the femur before walking age such as under a year are worthy of consideration

Can be incorporated into specific teaching resource on NAI

O3 Doctors entering clinical medicine must realise that this is a statutory requirement following the Laming report

Agrees with statement inclusion

P17 To a certain baseline level

E25 Record pattern of injury

E25 Be aware of non-accidental injury

R11 Separate point on NAI

Splitting the statement into 2 will acknowledge all 3 of these statements

R11 Record accurate history of key msk symptoms and effects on function / child & family

Dealt with in later statements

Question 5 (distinguish mechanical from inflammatory causes of MSK pain) 50%

P21 Too vague

O4 Ought to be aware of the causes of MSK pain, but less sure that we need to require them to distinguish them

R7 Have an understanding between mechanical and inflammatory causes of pain

RI14 Consider mechanical and inflammatory causes

E24 Be aware of some factors which distinguish between mechanical and inflammatory causes of MSK pain

R8 Have an awareness of differences

E28 Demonstrate awareness of

GP30 Identify inflammatory causes of MSK pain

P20 Know the features that are helpful in distinguishing mechanical from inflammatory causes – as a consultant paediatrician I quite often find children I have referred as possible inflammatory arthritis are sent back with a diagnosis of ‘joint laxity’

P18 knowledge of differences between inflamm vs msk

GP33 Where I have written modify – some of these responses require some sophisticated skills – so for example I would expect a final year student to know that it is important to try and differentiate between the mechanical and inflammatory but not expect them to be competent at it

R11 Be aware of features in the history that point to a mechanical or an inflammatory cause of musculoskeletal symptoms

All the above comments suggest a rewording of the statement and lowering of the skill level a medical student can achieve.

GP35 Have an idea from hx and what to look for on examination, although may have difficulty in eliciting the clinical signs

This will come into examination

P18 establish whether systemically unwell vs local problem

This is dealt with in later statements

Question 6 (demonstrate awareness of developmental considerations when asking about inflammatory symptoms) 63.6%

P18 But huge challenge to expect me and students to have full developmental and full communications skills

GP31 To demonstrate awareness, but takes some experience to get full feeling of this

R8 Have an awareness of...

GP36 Important but not sure how you do this

GP33 Where I have written modify – some of these responses require some sophisticated skills – so for example I would expect a final year student to know that it is important to try and differentiate between the mechanical and inflammatory but not expect them to be competent at it

This question has been removed and question 1 inserted in it's place. These comments can all be grouped into an unrealistic level for a student to achieve. The skills expected in the original question can be achieved in combination of question 1 and 5

O3 This is confusing, inflammatory conditions are painful, developmental are not, pain is a red flag

Red flags are dealt with in a later condition.

Question 7 (recognise red flags and symptoms) 90.9%

O2 Weight loss extremely uncommon in children's orthopaedics, even in those with cancer so not a good example – differentiation of mechanical and non-mechanical pain (also applies to adults) important. Also from studies looking at sarcomas in children 'pain at strain' is much more common than night pain – it's recognition of the dull, boring and persistent pain that's important in diagnosing tumours and infection

R11 Recognise symptoms such as night pain, weight loss, fever raising the possibility of malignancy or another condition with potential to cause significant ill health

Will be acknowledged in teaching resources with greater expansion of red flag symptoms and signs (case study on child with malignancy and description of pain) but statement modified to take these points into account

E28 Record with awareness of

This is a similar level to the statement already included and does not change the meaning of the statement

Question 8 (review functional limitations taking into account child's developmental stage) 60.6%

P18 No - Should be able to document abnormality – suspect a problem and refer appropriately

GP31 only to baseline level

E24 Be aware that child's development will influence the pattern of functional limitations

R8 Have an awareness of...

GP34 I'm not sure what you mean here in the context of history taking

R6 modify – doesn't say how

GP33 Where I have written modify – some of these responses require some sophisticated skills – so for example I would expect a final year student to know that it is important to try and differentiate between the mechanical and inflammatory but not expect them to be competent at it

This comment is incorporated into the new question 1 with acknowledgement that all the above comments suggest this question is ambiguous.

Question 9 (record a full pain history) 66.7%

P21 more detail needed here

P20 Not sure I know how to do this properly – what exactly does this mean?

O4 Assess pain in patient's history

Expanding this statement gives more explanation which acknowledges all the above

O2 add 'appropriate for stage of development', ensure site of pain accurately identified in particular

Development taken into account in question 1. Site of pain listed in new statement

O3 Using appropriate tools (pain diagrams etc)

R11 And assess level of pain

Dealt with in next question

Question 10 (assess level of pain) 63.6%

P18 Yes - translatable skills across all disciplines. Need to know how to assess pain levels in paed

RI15 use age appropriate tools/scales to quantify pain

P21 using pain scores presumably?

P20 using simple tools

E25 Taking into account age of child

All relate to specifics of how pain is assessed and acknowledged in rewording

E22 Should this be part of examination?

Pragmatically best dealt with here in relation to previous question

E28 Record with awareness of

Don't think this accurately reflects skill

Question 11 (relate social history to MSK complaint) 90.9%

P18 Yes where possible

O3 This potentially prejudices the diagnosis. Social issues should be in the diagnosis of exclusion box. Dancers can have spondylolisthesis, bullied kids can get cancer

Not sure how to acknowledge this comment. Undergraduate teaching is about the 'norm' and recognising patterns and deviations from these. Not everything follows set patterns but without the knowledge it's difficult to reach diagnoses! This statement could potentially be removed if I can acknowledge this comment somehow.

R11 Recognise the importance of a full family and social history and to assess the effect of musculoskeletal complaints on these

Effect on musculoskeletal is implicit in the stem of the question and over-riding introduction

Possible rewording of statement included

Question12 (record a developmental history) 90.9%

P18 Perhaps document a change / slowing in achievement of milestones

This will come into regression of motor milestones in core presentations

RI15 record a **brief** developmental history

O4 Limited e.g. birth history, able to sit, when walked

statement reworded to acknowledge both of these comments

Question 13 (recognise the importance of full family and social history)
97%

R11 Recognise the importance of a full family and social history and to assess the effect of musculoskeletal complaints on these

Included within question 9 on family and social hx

Question 14 (include a MSK history in all history taking encounters)
60.6%

P18 Yes – if can do an accurate history within the limitation of 1 -2 screening questions

O2 probably should be brief with questions around functional restriction, limb pains and joint swelling for example

O4 ‘screening’ history

P20 using simple tools

RI14 Include MSK screening questions in ‘review of systems’

P17 Brief screening – systems review

P21 No just systematic review

P19 Include a musculoskeletal history as a part of ‘systems review’ in all history taking encounters

R11 Include a screening musculoskeletal history in all relevant history taking encounters

All above acknowledged in reworded question 10

GP34 I certainly don’t do this as such. Do you mean include questions that allow you to include/exclude a MSK cause for the child’s problems?

GP36 Should be but not always done! Difficult as often professionals do not do this therefore learnt behaviour not to.

E28 Consider need for...

Really appropriate with child with petechial rash etc

Added question 11 takes into account specific situations where more extended history needed

Comments - history taking

O2 A lot of this is fairly generic so nothing new, but I’m sure you’re aware of that.

GP31 Some of the above are mainstream history taking which are vital components. Assessing symptoms with development is an area which needs highlighted but awareness of difficult nature of assessing this at times by staff

Included in question 1

GP34 The biggest problems we face with medical students is the compartmentalising of history taking and I think this is even more of a problem with paed. I understand you are coming from a MSK perspective but in truth kids usually present in a way that requires social/developmental/neuro MSK history to be taken

Social and developmental history also included in here. Neuro is different syllabus

GP33 Where I have written modify – some of these responses require some sophisticated skills – so for example I would expect a final year student to know that it is important to try and differentiate between the mechanical and inflammatory but not expect them to be competent at it.

Acknowledged in rewording particularly of levels

GP36 ? Development of CD ROM similar to the adult CD used in stage 3 teaching for undergrads. Presently no resource for children's examination

Already exists! Relates to teaching resources

Examination

Question 15 (employ distraction techniques to maintain co-operation) 81.8%

GP32 This is likely to come with experience

Acknowledge this by lowering level

o4 Aware of the importance of...

R12 In an attempt to maintain co-operation

R8 Demonstrate they can engage children in clinical examination and examine them without discomfort

R11 Employ a comfortable atmosphere to maintain co-operation and distraction techniques when needed

Above comments incorporated into new statement

GP33 See comments (examination)

Question 16 (demonstrate awareness of developmental staging) 87.9%

P17 Not sure how specific this is?

R6 modify – doesn't say how

Do you think this can come out in view of developmental acknowledgement at the start? – agreement from research team

Question 17 (perform screening examination) 93.8%

O2 But be aware of pGALS limitations in non-rheumatological disorders

O3 I don't know what this is

Neither of these comments help in modification. A screen is only meant to be that and is not meant to pick up all conditions. Further explanation given

Question 18 (perform appropriate regional MSK examination) 75.8%

P18 Ideally but would feel more important that know what / who to refer to

GP35 Difficult to know specifics in children at this stage, not sure I can do this myself!

O2 using look **feel** move

P20 This is quite a lot to take in - 'understand the principles of MSK regional examination and be able to apply them to a variety of joints'

Statement modified taking into account bottom 2 comments

Question 19 (recognise leg alignment at different ages and normal variants within this) 75.0%

P18 Recognise **common** leg alignment

O4 awareness of these normal patterns

GP30 Be aware of variation of leg alignment at different ages

GP35 In outline

R9 Awareness with some examples: not comprehensive

R8 Be aware of normal variants of the musculoskeletal system at different ages in childhood

These comments share a theme of knowing what's common but at a lower level for the medical student

o5 should recognise each

Listed in reworded statement

Question 20 (recognise when normal variants require referral) 38.7%

P21 think this might be too difficult

GP35 postgraduate

GP36 ?More postgrad but v useful for GPs

GP33 See comments (examination)

R6 modify – doesn't say how

GP32 Need to recognise limits of knowledge and when to ask for advice

RI14 Doesn't make sense – 'fixed flat feet' implies a pathological abnormality that needs referral, not a normal variant

R9 Awareness with some examples: not comprehensive

O1 Recognise the difference between normal variants (e.g. flexible flatfeet) and pathological counterparts (e.g. rigid flatfeet)

O3 Normal variants do not require referral. They are normal

I think this will get rejected as per the top 5 comments. Have tried to simplify and explain the statement that incorporates the bottom comments

Question 21 (perform assessment of full ranges of movements at all joints) 75.8%

GP32 principal joints

R10 I don't quite understand this question

P20 Thus us quite a lot to take in

P17 Would not expect detailed measurement

R8 Within context of qu. 19

As 'look, feel, move has been incorporated into statement 15 I'm not sure this question and the one following are necessary, which would acknowledge these comments – agreement from research team

Question 22 (elicit abnormality within range of movement at any joint) 75.0%

P21 within limits of co-operation of child

R10 I wouldn't expect them to know degrees of movement

GP32 principal joints

P20 This can sometimes be quite subtle. Is it important to be able to do it or understand the principles behind limited movement – what sort of pathology causes what sort of limitation?

E25 Elicit abnormality of significant asymmetry when examining joints

Have changed this question to acknowledge limitation of movement only and moved it to follow statement 15

Question 23 (describe increased flexibility of children's joints cf adults) 65.6%

Question 24 (recognise hypermobility benign) 60.6%

O1 Understand the relationship of joint ranges of movement to development (e.g. femoral anteversion normal in infancy, diminishing with childhood)
Incorporated into normal variants in statement 17

O2 questions 23 and 24 similar really – should be aware of hypermobility and it's diagnosis Beighton / Brighton scores

O4 The normal

O3 And understand the significance of

P20 There is a range of normality. 'Know that in general children have less flexibility than adults'

E22 Difficult to objectively differentiate the two I think

GP31 Getting quite specialised assessment

O3 This is very difficult to quantify. Benign hypermobility is a normal variant. It does not need to be medicalised and does not need to be referred. The clinician needs to have an appreciation of what pathological laxity looks like

GP35 Difficult

P20 There is a range of normality. 'Know that in general children have less flexibility than adults'

RI14 To ask students to recognise hypermobility requires standards for all ages which do not exist.

E28 Incorporate assessment outside of MSK to distinguish non-benign

R11 Be aware of increased flexibility of children's joints cf adult especially of the younger child

R11 Recognise joint hypermobility

Have combined both statements. I can't find anything in these comments that's more than 'this is quite difficult' and 'they need a baseline awareness'

Question 25 (distinguish between benign and non-benign hypermobility) 25.0%

O3 This is very difficult to quantify. Benign hypermobility is a normal variant. It does not need to be medicalised and does not need to be referred. The clinician needs to have an appreciation of what pathological laxity looks like

This is indicated in the above question

GP32 be aware of possible significance

P20 Be aware of non-benign hypermobility

R9 Awareness of difference

GP34 As an idea at least. I've never seen it in 20 years GP. Difficult

RI14 Consider syndromes associated with hypermobility (e.g. Marfans, Ehlers Danlos)

GP31 Specific common examples yes

R8 Understand there are rare and serious medical conditions associated with hypermobility

GP33 See comments (examination)

E28 Incorporate assessment outside of MSK to distinguish non-benign

Statement modified to state Marfan's and Ehlers' Danlos only which should simplify the statement and answer most of these comments.

R11 Be aware the joint hypermobility may represent an underlying condition e.g. Marfan's syndrome and know which key suggestive signs to look for

Associated signs within Marfan's too complex taking into account statements above, think its best left simple but still acknowledges this statement

Question 26 (recognise common skin associations) 84.8%

GP32 be aware there may be skin changes

R11 and nail

Statement modified to incorporate these

Question 27 (identify an acutely inflamed joint) 90.9%

O3 And appreciate the serious nature of septic arthritis (particularly of the hip and the need for urgent referral)

Comes into next question

P20 And know when some signs may be absent e.g. hip

This would come into more detailed teaching about recognition of the inflamed joint but is not necessarily a learning outcome, is that ok? – agreement from research team

R11 Identify an inflamed joint (ie active synovitis)

Statement modified – acute taken out

Question 28 (recognise clinical features that differentiate between septic and inflammatory causes of joint swelling) 69%

P18 yes – transferable skills not only related to paediatrics or rheumatology

O3 And appreciate the serious nature of septic arthritis (particularly of the hip and the need for urgent referral)

P20 Understand the principles of differentiating an inflamed joint from a septic one (we often need an ultrasound, FBC etc)

O4 Awareness of the features

E24 Be aware that an acutely inflamed joint may be septic or inflammatory

E28 recognise red flag features

O1 Differentiation can be very difficult. I would rather say ‘Recognise criteria raising clinical concern of a septic joint and the place of appropriate investigations’

P21 more difficult? More detail

R10 Sometimes difficult as a consultant! Recognise the possibility.

R6 modify – doesn’t say how

Modification of this statement has taken into account red flags, investigations and referral which will acknowledge all comments. Inflammatory arthritis is a diagnosis of exclusion so in the acute setting recognition of sepsis is important, inflammatory arthritis will come into differential within core presentations of inflamed joint, covered in table

O1 Differentiation can be very difficult. I would rather say ‘Recognise criteria raising clinical concern of a septic joint and the place of appropriate investigations’

R11 Recognise clinical features that raise the possibility of a septic arthritis

Statement is now more explicit in recognising the septic joint

Question 29 (elicit clinical features of non-infectious causes of MSK pain/swelling) 56.3%

P18 no – referral to paediatrician or appropriate clinician more important

P20 Be able to recognise?

R6 modify – doesn’t say how

GP33 See comments (examination)

Having changed earlier question to recognition of an inflamed joint (taking out acute) and with differential coming into core presentation this statement has come out

Question 30 (observe and describe gait pattern) 87.9%

GP32 be aware of importance of gait

O3 But not in great detail. This is a science in itself

O4 As for pGALS

O2 Yes but only in very broad terms 'intoeing and out toeing, limp, toe-walking and normal'

R9 Common gait patterns

R12 Yes - may not use appropriate language

O1 This is poorly taught but should be included – at least at a rudimentary level in recognising classical (e.g. antalgic) pathological gait types.

O5 In very basic terms

Comments reflecting keeping this simple so have added in 'principle' and examples of simple patterns that students might observe and are commented on in pGALS.

Any other comments? - none

Question 31 (describe gait pattern at different developmental stages) 33.3%

GP36 How important is this?

O1 I think this is postgrad level

These comments reflect likely rejection!

P21 Yes – very briefly

O4 Awareness of...

R12 Yes – broad review only

R8 Be aware of different gait patterns...

GP31 Becoming too specialist?

P20 Describe the changes in gait pattern between a child starting to 'toddle', a young child (Fogg) and an older child

R9 Key developmental stages

Statement modified to include bottom 2 comments that reflect the brevity required from those above

Question 32 (perform neuro exam in the context of back pain) 81.8%

P20 And know how to adapt it for a child

Is this not implicit in a paediatric questionnaire? Also acknowledged in developmental question 1

GP35 Difficult in a child

O2 I can't so don't think they should be able to describe it – I think it's too much detail for them

Statement not modified

R11 and identify abnormality

This statement in 2 so students know to examine and what to look for – may be too much to expect clinical findings?

Question 33 (describe important neuro associations with back pain) 81.3%

P21 such as? More detail

O2 not sure what you mean

O4 Awareness of...

R9 some important

Have added in the word 'some' and an example

Question 34 (elicit signs of proximal myopathy) 84.4%

P18 would be more concerned that weakness could be elicited even if the location of weakness not found. Would then expect referral to paed

O4 Awareness of...

O3 This is something that should be discussed at a more senior level

GP33 See comments (examination)

Statement modified to simplify level

Comments - examination

P20 I think the bar has been set a little high here

GP33 Where modify = these are higher order skills than I would expect of a student – and would expect to teach to a registrar. If the stem said 'be aware of' I would accept

E25 Some of the above are more suited to trainees with more paediatric experience

GP34 The only issue here is that a lot of the signs are rare and I don't know how much exposure a med student will have to be able to demonstrate them

All of these comments reflect the correct level expected and modifications made to reflect these. Haven't used 'be aware of' as not a learning outcome?

P17 Would not expect students to be completely confident in exact diagnosis – but expect them to identify abnormality; have a logical differential diagnosis according to clinical features and plan further investigation/referral

Good comment but does not require change

R8 Demonstrate they can engage the child in clinical examination

Reflected in opening statements

GP36 Referral of normal variants ?should this be taught in postgrad – could be included in GP training half day study sessions on the VTS as group learning. May not be taken in undergrad level.

Normal variant question modified, rest of comments not relevant

R11 qu 41 should be in this section

Qu 41 has been modified so left in original place

Investigations

Question 35 (identify when FBC, CRP, ESR indicated) 90.9%

RI14 Identify the role of blood tests such as...

Nice comment, statement changed to reflect this

R6 Be aware of role of investigations but not possible to understand the multitude of investigations a medical student should know

R12 Yes – understand limitations

Limitations not covered in this statement but likely to be covered in discussion on interpretation

O3 This is something that should be discussed at a more senior level

Not asking students to perform these investigations but be able to discuss/identify as per the statement – opening line changed to reflect this

Question 36 (interpret results of FBC, CRP, ESR in MSK disease) 81.8%

P18 yes – no point in doing tests unless you can understand results

GP32 Be aware of normal variants and identify when to discuss care with supervisor if abnormalities

R9 Attempt to interpret

R6 Be aware of role of investigations but not possible to understand the multitude of investigations a medical student should know

O3 This is something that should be discussed at a more senior level

Statement modified to reflect a student looking at results and trying to understand them

Question 37 (discuss when bloods such as autoantibodies indicated) 45.5%

P18 no – still feel that these test should be performed by specialists e.g. paed/rheum/ortho

O3 This is something that should be discussed at a more senior level

GP35 A rough idea only

P17 Not sure would expect student to know which further tests and why - ?too advanced - ?ST1-2 level

GP31 To be generally aware but not too many specifics

GP36 Depends on what level are taught

Question 38 (interpret above) 21.2%

O3 I don't understand the relevance of this – please expand

P17 To an extent – be aware of

GP31 In general yes

R6 Be aware of role of investigations but not possible to understand the multitude of investigations a medical student should know

GP36 postgrad

Think both of these statements will be rejected and not sure if I can modify them in any way to make them more acceptable. There is nothing new in the comments. Only suggestion is something along 'recognise that specialists may request further

tests such as autoantibodies, muscle enzymes, ferritin' but this doesn't seem like a good learning outcome. Statements changed to 'discuss' but think they will be rejected

Question 39 (differentiate role of different radiological investigations) 54.5%

P21 discuss not differentiate

E28 discuss

RI14 Differentiate the pros and cons of different radiological...

R9 Predominant role of...

O4 At level of bony detail = CT, soft tissue = MRI

GP35 Limited knowledge only

R8 Have an awareness of the limitations of radiological investigations e.g. X-ray to 'diagnose' JIA inappropriate

This is a specific example that may come into teaching resources

GP36 'Appropriate and inappropriate use of X-rays' may be more appropriate for undergrad level

R6 Be aware of role of investigations but not possible to understand the multitude of investigations a medical student should know

Question 40 (explain indications and purpose of a bone scan) 33.3%

P21 too difficult

O2 Rarely used really, so is it relevant now? Not sure it's core knowledge

R10 Bone scans rarely used in our practice now

P18 yes – a transferable skill not specific to paediatrics or rheumatology therefore important to know indications in different diseases and the differential that the results might involve e.g. bony mets

R9 Main indications and purpose

E25 Know that the bone scan can be a useful investigation

E24 Be aware of the possible uses of a bone scan

GP36 'Appropriate and inappropriate use of X-rays' may be more appropriate for undergrad level

E28 discuss

O1 add – 'and an awareness of the risks and benefits of'

Combining the bottom 2 sets of comments, have separated plain X-ray from the other investigations which acknowledges comments relating to keeping things simple and the extra comments from O1 (below)

Have changed the following statement to discuss the other investigations including bone scan and specific indications.

Takes in almost everything

Comments - investigations

P17 I would expect sound understanding of basic investigation and awareness of further investigation and referral; danger if expect too much knowledge of more detailed investigation the students are overloaded and miss the sensible first line investigations they would be expected to do in clinical practice as F! /2 before referral on to appropriate specialty

Good comment, lends further weight to removal of 37/38

Gp34 I do wonder how much detail to expect here, especially of radiology

Statement modified

GP33 For me these are much higher order skills

?reflects difference between hospital and GP practice

O1 Have an understanding of the clinical threshold for radiographic examination and demonstrate an ability to describe a radiograph of an extremity injury.

Now in new statement 35

Management

Question 41 (employ anatomical landmarks in descriptions) 84.8%

O3 And appreciate the urgency of referral

R8 'I wish!'

Expanded to be more explicit

R11 should be in the examination section

Combined with statement on medical terminology, makes this clearer

Question 42 (relate history and examination findings to core conditions) 100% accepted and removed

O3 In the paediatric context needs senior input

this is not relevant to the statement

Question 43 (formulate provisional differential diagnosis for core presentations) 100% accepted and removed

R12 Yes – not expecting it to be correct

Question 44 (describe MSK presentations of malignancy) 97.9% accepted and removed

R11 no – already mentioned

Different action point (previous is about red flags this is may include swelling etc)

Question 45 (plan management of pain) 69.7%

O3 Only after discussion. One of the most common problems is conflicting advice

P20 Simple management plan using treatment ladder

GP31 Basic knowledge

E24 with help

Statement modified to give examples and simplified

Question 46 (use appropriate medical terminology in referral) 93.9%

O3 Only after discussion. One of the most common problems is conflicting advice

Combines with anatomical landmarks question as similar

Question 47 (describe when specialist opinion necessary) 63.6%

GP32 be aware when referral may be necessary and to discuss with supervising clinician

GP31 basics

GP34 In terms of core conditions?

Modified and simplified

Question 48 (communicate provisional management plan verbally to child and family) 90.9%

P21 once discussed with doctor

Changed in statement

Question 49 (liaise with other healthcare providers) 81,8%

P21 No – only supervised

R9 Help liaise

'help medical staff' added to statement takes both of these

P20 physio

Added in

GP31 To certain extent

Question 50 (describe the roles of the MDT) 78.8%

O2 Not sure

O4 Awareness of...

R8 Awareness of importance of MDT

All above similar and statement modified

GP36 To what depth?

Now clearer in statement

Question 51 (outline principles of managing children with chronic disease) 87.9%

P18 – yes ideally but may be too complex to understand full implications until they are managing similar patients

GP36 To what depth?

Examples given in statement

Comments - management

RI14 To plan management the students must first summarise the care with a succinct 'impression'

R8 Put the history and examination together in a logical manner demonstrating understanding of the importance of key features in the history and examination which lead to the diagnosis and differential diagnosis. This is a skill I find lacking across the curriculum. They just repeat the mum's history!

R11 Relate salient point to senior doctor / other health professional to develop final management plan

Above 2 comments similar and extra statement added

GP33 Outlines I agree – specifics – especially drug management is higher order

Drug management of pain modified

O1 Have an understanding of the Salter-Harris classification of epiphyseal injuries and the management/prognostic significance thereof.

I think this is a specific that would come into the management of fractures and will therefore be relevant to core conditions and be relevant for teaching resources

Core conditions

JIA

GP37 Not necessary to make diagnosis but recognise as differential

E22 Need to know as a part of differential diagnosis than actual clinical recognition

If clinical features known then can be included in differential

Septic arthritis

O2 Differentiate from reactive arthritis, understand need for urgent treatment

O3 Recognise that this is an emergency

Red flags included in earlier content

Osteomyelitis

O3 Recognise that this is an emergency

GP37 Awareness of red flag, not necessary to know full diagnosis

Red flags included in earlier content

E28 Infections broadly

Above 2 combined

DDH

O2 And should have been taught neonatal hip examination

Included within neonatology

P20 And talipes

Added in

E22 Should be aware of what and how to elicit – but can learn during postgraduate re demonstration and recognition

Column headings changed

Perthes

RI14 awareness of condition

E22 Need to know as part of differential diagnosis

Column headings changed

SUFE

O3 Recognise that this is an emergency

Red flags included earlier

RI14 awareness of condition

E22 Need to know as part of differential diagnosis

Column headings changed

Malignancy

O2 Awareness only and key presenting features – details of treatment not required

O5 awareness without specific knowledge

Column headings changed

GP37 Awareness of red flag

Red flags included earlier

Scoliosis

O2 Know how to do forward bending test and look for leg length discrepancy

Added in to examination

O5 awareness without specific knowledge

Column headings changed

Common fractures

P20 Pulled elbow

added in

E22 would get covered with orthopaedics

acknowledged in opening statement

R11 Know when operative management needed acutely (nerve/blood vessel concerns)

?would come into specific teaching about this presentation? – key clinical features and complications?

Multiple fractures

RI14 Awareness of condition is vital

GP37 Awareness needed of implication of NAI

Not changed

Normal variants

RI14 Too vague

GP37 Not necessary to know all normal variants

GP36 Not sure what these should be

more information given

O5 Aware of existence

Column headings changed

Rickets

GP37 Need to recognise abnormality but not necessarily diagnosis

GP36 How often seen?

GP36 Rickets - ?how often seen. Have never come across case.

Reflects practice? Left in.

O5 Awareness in relation to race

Specific teaching point that would need addressed in resources

Other comments on core conditions

E23 The majority of these conditions could be mentioned but cross-referenced to other areas of the syllabus / learning objectives where appropriate

O2 Congenital muscular torticollis – all categories

Added in

Clubfoot – all categories ad differentiate from postural CTEV

Included as category

What about the assessment of leg length – clinical and blocks – no tape measures (!)

In examination section

P20 flat feet

In normal variants

RI14 Non-organic pain – to be aware of the condition and key features, consider within differential diagnosis

Included in core presentations

P17 Secondary MSK conditions due to chronic disease ie postural management in CP – hip/spine.

Not a core MSK presentation, appropriate history and examination should be transferable

P17 Osteopenia in children with chronic disease and nutritional deficiencies

Secondary and not primary MSK condition. To be addressed in teaching resource.

GP37 Probably not possible to be aware of all normal variants but should be aware that may be the diagnosis if red flags not present and investigations negative

Statement modified

E28 Child with a limp – broad differential

Included in core presentations

Need training on 1st principles of distinguishing congenital vs acquired – infective, inflamm, neoplastic

Within history and examination

Core – ‘conditions not to miss at midnight – viz septic arthritis, NAI

Included already

R11 Benign joint hypermobility syndrome

Recognition of hypermobility included within examination findings, not sure whether to include this?

R11 Chronic idiopathic pain syndrome

This is quite specialised and purposefully hasn't been included so far. It's a differential of pain – but is it a core condition? Added in

R11 Nocturnal idiopathic pains

O5 Growing pains – common diagnosis or exclusion

Needs added in

Core presentations

Swollen joint

O3 Recognise that this is an emergency

Within red flags

GP37 Should be aware from general medicine

Acknowledged in opening statement

Arthralgia

R10 comes into a swollen joint

pain is different to swelling

RI14 describe initial management depending on differential

GP37 In very general terms

Have made no changes

Fracture

RI14 Should be covered in orthopaedics

Acknowledged in opening statement

O5 recognise relevance of physeal injury

Is this specific teaching knowledge that would be dealt with by teachers?

Muscular pain

R10 I'm not sure which diagnoses you're getting at

GP31 ?too specialised

O5 uncommon in child

See comment in table

Back pain

GP37 Should be aware of as part of general medicine

Acknowledged in opening statement

R11 Awareness of very high radiation involved in spinal x-rays esp. lumbar spine

Awareness of red flags

Specific teaching points that would come into teaching resource

Unexplained fever

RI15 included in other parts of syllabus – infectious diseases

O5 paed syllabus

Acknowledged in opening statement

Regression in motor milestones

RI15 included in other parts of syllabus – neurodevelopment

O5 paed syllabus

Acknowledged in opening statement

O3 refer

GP31 ?too specialised

Other comments on core presentations

E27 Child with a limp / swollen joint / bruising – these 3 presentations cover almost all the key diagnosis

May well be the only ones included!

RI14 What about swollen joints as opposed to a swollen joint?

Added in

GP34 loss of function – ‘he’s not using his arm doctor’

I think this would be a similar approach to a limping child,- have added in

and maybe something on neuro/msk differential

not sure how to acknowledge this as this can be hard and is very specialised, would come into differential diagnosis and perhaps covered in a teaching resource e.g. case?

GP37 For certain core presentations it may not be necessary to have specific inclusions in the syllabus which will be covered in general orthopaedics/rheumatology/medicine though graduates should have an understanding of features, differential etc – ie back pain but students need to recognise these will be different differentials in children

Acknowledged in opening statement

GP36 Normal variants – not sure what would be included here

expanded

Paediatricians may have a different view to a generalist is dysplasia of hip, Perthes, slipped epiphysis. Not seen v often in GP

different views of generalist vs specialist

R11 If including fractures / injury should be more in clinically indentifying fractures

Added in to x-ray statement

R11 Awareness of management of soft tissue injury (RICE)

Added in to management

Comments - any other

E27 Remember there are only MAX 10 weeks to teach all paediatrics. At most your direct teaching time will be ~4-5 hours

E25 As a paediatrician I find it hard to think about the generalist (ie non-paediatric non-specialist). I feel they need to have a core bone knowledge – we have to be careful not to make it too detailed and specialised

Acknowledged in opening statement

R12 We should concentrate on history taking and examination. Begin to link clinical findings to conditions primarily to make them interesting rather than because newly qualified doctors need to know the treatment or management of specific conditions. They will only learn these latter skills when they have patients to remember them by. Also, treatments change but clinical findings and conditions do not.

GP31 Medical students need to be able to perform a good history and examination and giving them skills to do this in rheumatology paed cases is most important aspect – management/treatment/differential can be learnt later

P17 Learning outcomes are a continuum through undergraduate and postgraduate training – basic knowledge and awareness is key for medical students; I would not expect them to know detailed investigation and management plans

Headings within tables changed to reflect the above 3 comments

E23 You run the risk of expanding the list of conditions too much. A list of additional conditions for the students to know about and where else they occurs in the course may be more beneficial

Acknowledged I opening statement and will be part of final toolkit

GP35 I think students have enough to learn on adult rheumatology. As a GP I translate useful information as to what I use in surgery so: limp, normal orthopaedic variants, to recognise inflamm arthritis, scoliosis, red flags of tumour and septic arthritis

All included

GP34 V important to teach the difference between failure to achieve milestones and milestone regression

Core presentation changed

E22 pGALS should be mandatory

Included statement 14

E22 Approach to recognition, management and referral should be part of core presentation for most common conditions

Appendix 9 Delphi 2



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Delphi Questionnaire Round 2

Paediatric musculoskeletal medicine for medical students

Thank you for your contribution to Round 1 of this Delphi process. Your input, time and comments have been gratefully received and appreciated. I very much hope you will be able to contribute to Round 2, which I hope will be much quicker for you to fill in!

This questionnaire incorporates the results of Round 1, which have also been sent to you for your information. (Attachment: Delphi 1 results). Some questions have already been accepted for inclusion and are not included in this round. Other statements have been modified taking into account your helpful comments.

The function of this final round is to achieve final agreement on which statement should be INCLUDED or EXCLUDED within a curriculum for paediatric musculoskeletal medicine. What we would like you to do is read each statement carefully, indicating your final decision by ticking the yes or no box.

In making your decision, please keep the following in mind:

There is overlap between other areas of the paediatric, orthopaedic and medical syllabus of which we are aware, and will highlight on the final product. Devising a curriculum specifically for paediatric musculoskeletal medicine will ultimately help students and teachers alike.

A secondary part of this research is to produce teaching resources for paediatric musculoskeletal medicine. Those comments and modifications that relate to teaching content will be incorporated into those resources, and your contribution to this has been valuable and appreciated.

Please read each statement carefully. Accepting this statement means this is something you would expect a medical student at the level of graduation to achieve. Rejecting this statement means you do not think a medical student at the level of graduation should be able to perform this activity. There is no opportunity to change statements.

Please proceed with **one of 2 options only indicating in the box provided:**

1. **Yes** = this statement content should be included
2. **No** = this statement content should not be included

All responses will be anonymised, we ask for your position for coding purposes only.
This study has had full ethical approval.

Specialty	Please tick
Orthopaedic surgeon	
Paediatric Rheumatologist	
Paediatrician with interest in rheumatology	
Paediatrician	
GP	

Section 1

On **establishing interaction** with a child with a musculoskeletal complaint, a medical student at the level of graduation should be able to:

NEW. Modify history taking and examination according to child's developmental stage (e.g. questions about functional activities).

Yes ☐ No ☐

3. Respect privacy and confidentiality for the child and family.

Yes ☐ No ☐

Section 2

In **History taking** from a child with a musculoskeletal complaint a medical student at the level of graduation should be able to:

4. Record pattern of injury.

Yes ☐ No ☐

NEW. Demonstrate awareness of injury patterns suggestive of Non-Accidental Injury.

Yes ☐ No ☐

5. Recognise features in the history that may distinguish mechanical from inflammatory musculoskeletal pathology.

Yes ☐ No ☐

7. Recognise symptoms such as persistent pain, night pain, fever and weight loss as red flag symptoms for malignancy or significant systemic disease.

Yes ☐ No ☐

9. Elicit and document a pain history (site, character, radiation, aggravating and relieving factors).

Yes ☐ No ☐

10. Use a pain score or simple tools to assess level of pain.

Yes ☐ No ☐

11, 13. Recognise the importance of a full family and social history and their relevance to musculoskeletal presentations.

Yes ☐ No ☐

12. Identify major milestones within development.

Yes ☐ No ☐

14. Include a brief musculoskeletal history in review of systems in all history taking encounters.

Yes ☐ No ☐

NEW. Recognise the need for extended musculoskeletal history in certain presentation (e.g. limp, pain, rashes, refusing to walk).

Yes ☐ No ☐

Section 3

In the **examination** of a child with a musculoskeletal complaint a medical student at the level of graduation should be able to:

15. Demonstrate an understanding of ways to engage children when examining to maintain co-operation and minimise discomfort.

Yes ☐ No ☐

16. Demonstrate awareness of developmental staging.

Yes ☐ No ☐

17. Perform an examination that screens the musculoskeletal system (e.g. paediatric Gait, Arms, Legs, Spine) understanding that positive findings should lead to more detailed examination.

Yes ☐ No ☐

18. Demonstrate the principles of regional musculoskeletal examination incorporating a look, feel, move approach.

Yes ☐ No ☐

NEW. Demonstrate awareness that limitation of movement of joints could arise from pathology within the joint, muscle or bone.

Yes ☐ No ☐

19. Demonstrate awareness that leg alignment and foot posture changes with age and normal variants within these - knock knees, bow legs, flat feet, in-toeing.

Yes ☐ No ☐

20. Recognise when patterns of leg alignment and foot posture deviate from normal and may require referral, e.g. non-mobile flat feet.

Yes ☐ No ☐

23, 24. Recognise that normal children have increased joint flexibility compared to adults and may be hypermobile.

Yes ☐ No ☐

25. Recognise that Marfan's and Ehler's Danlos syndromes may be associated with hypermobility.

Yes ☐ No ☐

26. Recognise that skin and nail abnormalities may be associated with musculoskeletal disease (e.g. nail pitting, rashes).

Yes ☐ No ☐

27. Identify clinical features that suggest an inflamed joint.

Yes ☐ No ☐

28. Recognise clinical features suggestive of a septic joint and the place of appropriate investigations and referral.

Yes ☐ No ☐

30. Observe and describe principles of gait patterns (e.g. symmetry, leg alignment, presence of pain, limp).

Yes ☐ No ☐

31. Describe key developmental changes in gait pattern with age from broad based toddler gait to normal gait in childhood.

Yes ☐ No ☐

32. Demonstrate awareness that a neurological examination may be indicated (e.g. in the context of back pain).

Yes ☐ No ☐

33. Describe important neurological associations with back pain such as paraesthesiae and loss of bladder / bowel function.

Yes ☐ No ☐

NEW. Assess for leg length discrepancy.

Yes ☐ No ☐

NEW. Assess for scoliosis by inspection and forward bending.

Yes ☐ No ☐

34. Elicit signs of muscle weakness and be aware of the possibility of proximal myopathy.

Yes ☐ No ☐

Section 4

In considering **investigations** in a child with a musculoskeletal complaint a medical student at the level of graduation **would not be expected to carry out these investigations**, but should be able to:

35. Identify the role of blood tests such as FBC, ESR, CRP.

Yes ☐ No ☐

36. Discuss results of FBC, ESR, CRP in context of musculoskeletal presentations and potential implications (e.g. raised white cell count and possible sepsis).

Yes ☐ No ☐

37. Describe when blood tests such as autoantibodies, muscle enzymes, ferritin are indicated.

Yes ☐ No ☐

38. Discuss positive autoantibody, raised muscle enzymes or ferritin results in the context of musculoskeletal presentations.

Yes ☐ No ☐

NEW. Discuss the indications for plain X-ray.

Yes ☐ No ☐

NEW. Demonstrate a systematic approach to interpretation of plain X-rays (e.g. of bony fracture).

Yes ☐ No ☐

39. Discuss the purpose of other investigations such CT (to look at bone), MRI (to look at soft tissue) or bone scan (to look for inflammatory disease such as bony metastases or osteomyelitis).

Yes ☐ No ☐

Section 5

On **formulating a management plan** to discuss with their teachers for a child with a musculoskeletal complaint a medical student at the level of graduation should be able to:

NEW. Summarise key points in the history and examination to form an overall impression of the presentation.

Yes ☐ No ☐

NEW. Demonstrate a structured 'surgical sieve' approach to a differential diagnosis (e.g. timing, possible aetiology such as inflammatory, infective, malignancy etc).

Yes ☐ No ☐

45. Plan and discuss a simple approach to the management of pain - use of a pain ladder, reassurance and simple analgesia (including principles of Rest, Ice, Compression, Elevation).

Yes ☐ No ☐

41, 46. Use appropriate medical terminology in discussion with professional colleagues including anatomical landmarks where appropriate (e.g. extensor, flexor surfaces, relation to bones, muscles or joints).

Yes ☐ No ☐

47. List specialist opinions that may be necessary for musculoskeletal conditions (e.g. *orthopaedics, rheumatology, ophthalmology*) and discuss when this may be relevant.

Yes ☐ No ☐

48. Communicate provisional proposed management plan verbally to child and family after discussion with their teachers.

Yes ☐ No ☐

49. Help medical staff in liaising with other healthcare providers regarding management plan e.g. nursing staff, GP, physiotherapist

Yes ☐ No ☐

50. Demonstrate awareness of the importance of a multi-disciplinary team in managing a child with musculoskeletal disease

Yes ☐ No ☐

51. Outline the principles of managing children with chronic disease (e.g. considering impact on school, play and family, need for medications and monitoring, and the role of healthcare professionals)

Yes ☐ No ☐

Section 6

Please indicate if the condition or presentation below should be included in a paediatric musculoskeletal syllabus. For core presentations, the skills in Sections 1 – 5 would be expected to be applied.

For core conditions, please indicate the level of knowledge that you think is necessary for a medical student to demonstrate at the level of graduation.

Insert 'y' (yes) if you agree this should be included, leave blank if not.

Core presentation 'The child with...'	Include in pMSK syllabus
	Y ?
A swollen joint	
Multiple swollen joints	
Arthralgia/polyarthralgia	
A limp	
A fracture	
Non-organic pain	
Back pain	
Loss of function (e.g. 'my child won't use his arm')	
An unexplained fever	
Regression in motor milestones (as opposed to delay)	

Core conditions	Include in pMSK syllabus	Describe key clinical features within history & examination (including red flags where appropriate)	Describe key complications	Describe initial approach to management (such as referral, basic investigations)
Juvenile idiopathic arthritis				
Septic arthritis and osteomyelitis				
Reactive arthritis				
Developmental dysplasia of the hip				
Talipes equinovarus				
Legg-Calve-Perthe disease				
Slipped Upper Femoral Epiphysis				
Bone and joint malignancy				
Scoliosis				
Common fractures such as forearm, elbow				
Multiple fracture including non-accidental injury				
Normal variants (intoeing, knock knees, bow legs, flat feet)				
Rickets				
Pulled elbow				
Congenital muscular torticollis				
Nocturnal idiopathic pain ('growing pains')				

Thank you for taking the time to fill this in. Your comments and opinions are very much appreciated and valued.

Sharmila Jandial, **arc** Educational Research Fellow

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Appendix 10 Introductory slides for Nominal Group Technique

What should medical students know about paediatric musculoskeletal medicine?



Sharmila Jandial - arc Educational Research Fellowship
Helen Foster, Jane Stewart

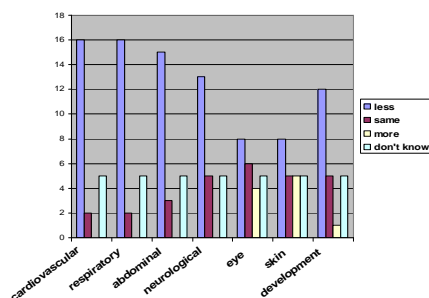


Why is this project needed?

- Doctors show poor performance (Myers) and report low self-confidence (Jandial in press) in their paediatric musculoskeletal (pMSK) clinical skills
- Delay in access to care for children with pMSK diseases well recognised (cancer, JIA, muscular dystrophy) – professional education highlighted as a contributory factor
- Current teaching: no consensus on what to teach
- UK medical school survey (child health)
 - pMSK content
 - History 39%
 - Screening examination 35%
 - Regional examination 22%
 - Included in assessment 26%

Why is this project needed?

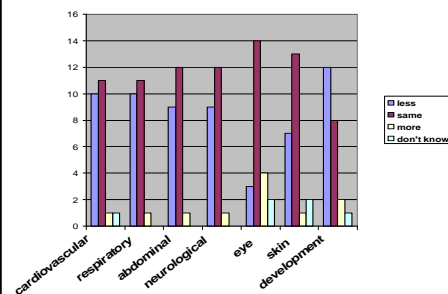
Child health leads were asked:
'How well are pMSK clinical skills taught compared to other systems?'



Less well taught
than all other
systems

Why is this project needed?

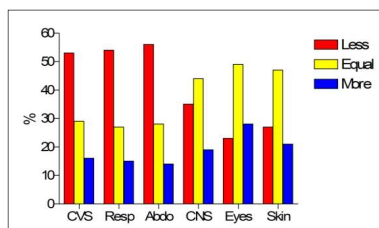
Child health leads were asked:
'How important are pMSK clinical skills compared to other systems?'



As important
as other
systems

pMSK clinical skills in practising doctors

>300 clinicians involved in the care of children self-rated their confidence in pMSK clinical assessment
<50% recalled any pMSK teaching, mainly at postgraduate level



Less confident than the 'main' systems, equal confidence in CNS, eyes, skin

A need to improve

- Paediatric teachers ask for resources and guidance on what to teach
- Students request consistency and reinforcement in clinical practice
- Differences between specialties eg rheumatology, orthopaedics, development needs acknowledged

Aims of this project

- To develop a pMSK curriculum for undergraduate medical students with learning outcomes to be achieved by the level of graduation
- To achieve consensus between all specialties involved in pMSK medicine
 - Orthopaedics, rheumatology, paediatrics including development/neurology/child protection, primary care, A&E
- To develop teaching resources that will enable any paediatric teacher to deliver this teaching

Progress so far

- Focus groups and interviews to explore views and opinions within all stakeholder groups on pMSK medicine
 - What should be taught
 - How best to teach it
 - Perceived barriers to teaching
- Proposed curriculum developed from analysis of this data
- 'Delphi' process to achieve consensus across a range of professionals on curriculum content
 - Importance of developmental awareness, normal variants and 'red flag' conditions consistent
 - Disagreement at depth of knowledge of pMSK diseases and awareness of management

Role of today's meeting

- Aim: to achieve final consensus!
- Objective: to discuss points of controversy/lower agreement and decide on their final inclusion or exclusion to the pMSK curriculum for medical students

Format of today's meeting

- Review of pMSK curriculum
- Participants to consider points with <80% agreement
 - 'silently' assign a cut-off point for inclusion
 - Group sharing of individually assigned cut-off points
 - Discussion/justification of differences
- Repeat 1 – 3 until agreement reached
- Then dinner!

Management	Plan and discuss a simple approach to the management of pain – use of a pain ladder, reassurance and simple analgesia (including principles of Rest, Ice, Compression, and Elevation).	79.4%
Management	List specialist opinions that may be necessary for musculoskeletal conditions (eg orthopaedics, rheumatology, ophthalmology) and discuss when this may be relevant.	79.4%
Examination	Demonstrate awareness that leg alignment and foot posture changes with age and normal variants within these - knock knees, bow legs, flat feet, in-toeing.	79.4%
Examination	Elicit signs of muscle weakness and be aware of the possibility of proximal myopathy <i>Round 1 Elicit signs of proximal myopathy (Gower's sign) 81.8%</i>	76.5%
History	Recognise features in the history that may distinguish mechanical from inflammatory musculoskeletal pathology.	73.5%
Investigations	Discuss the purpose of other investigations such CT (to look at bone), MRI (to look at soft tissue) or bone scan (to look for inflammatory disease such as bony metastases or osteomyelitis).	76.5%
Management	Help medical staff in liaising with other healthcare providers regarding management plan eg nursing staff, GP, physiotherapist	76.5%
Examination	Assess for leg length discrepancy.	64.7%
Examination	Describe key developmental changes in gait pattern with age from broad based toddler gait to normal gait in childhood	61.8%
Investigations	Describe when blood tests such as autoantibodies, muscle enzymes, ferritin are indicated.	58.8%
Examination	Recognise when patterns of leg alignment and foot posture deviate from normal and may require referral, eg non-mobile flat feet.	50%
Investigations	Discuss positive autoantibody, raised muscle enzymes or ferritin results in the context of musculoskeletal presentations.	33.3%

Core presentations

	Percentage agreement
A swollen joint	100%
A limp	100%
A fracture	94.1%
Multiple swollen joints	91.2%
An unexplained fever	85.3%
Loss of function	79.4%
Arthralgia/polyarthralgia	76.5%
Back pain	67.6%
Non-organic pain	57.1%
Regression in motor milestones	50%

Core Conditions

	Percentage agreement
Juvenile idiopathic arthritis	91.2%
Septic arthritis & osteomyelitis	97.1%
Reactive arthritis	91.2%
Legg-Calve-Perthe disease	91.2%
Slipped Upper Femoral Epiphysis	94.1%
Bone & Joint malignancy	91.2%
Multiple fractures including Non-Accidental Injury	91.2%
Normal variants	91.2%
Talipes equinovarus	84.8%
Common fractures eg forearm	84.8%
Nocturnal idiopathic pain (growing pains)	84.8%
Scoliosis	79.4%
Rickets	79.4%
Pulled elbow	70.6%
Congenital muscular torticollis	47.1%